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PENNSYLVANIA
GEOLOGICAL SURVEY
FOURTH SERIES
BULLETIN C 2

GEOLOGY
AND
MINERAL RESOURCES
OF
GREENE COUNTY
PENNSYLVANIA

By
RALPH W. STONE

Department of Internal Affairs
Philip H. Dewey, *Secretary*

Topographic and Geologic Survey
George H. Ashley, *State Geologist*

Harrisburg, Pa.
1932

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PENNSYLVANIA

LETTER OF TRANSMITTAL

Harrisburg, July 1, 1931.

Honorable Philip H. Dewey,

Secretary, Department of Internal Affairs

Dear Sir:

I am transmitting herewith a report on the Geology and Mineral Resources of Greene County, by Mr. R. W. Stone, Assistant State Geologist.

The geology of this county was worked out in some detail more than twenty years ago, but the reports on it published at that time have long been out of print. In the meantime, this county has become one of the leading oil and gas counties, and with the building of the broad-gauge railroad to Waynesburg, promises to become one of the principal bituminous coal producers of the State, as, next to Washington County, it has more undeveloped coal than any other county in the bituminous field.

Because of this growing interest in its mineral resources and the lack of available reports with which to answer the many requests for information, it has seemed well to prepare this report, bringing up to date the development going on in the county, and making minor corrections in the geology.

Respectfully submitted,

Geo. H. Ashley

State Geologist.

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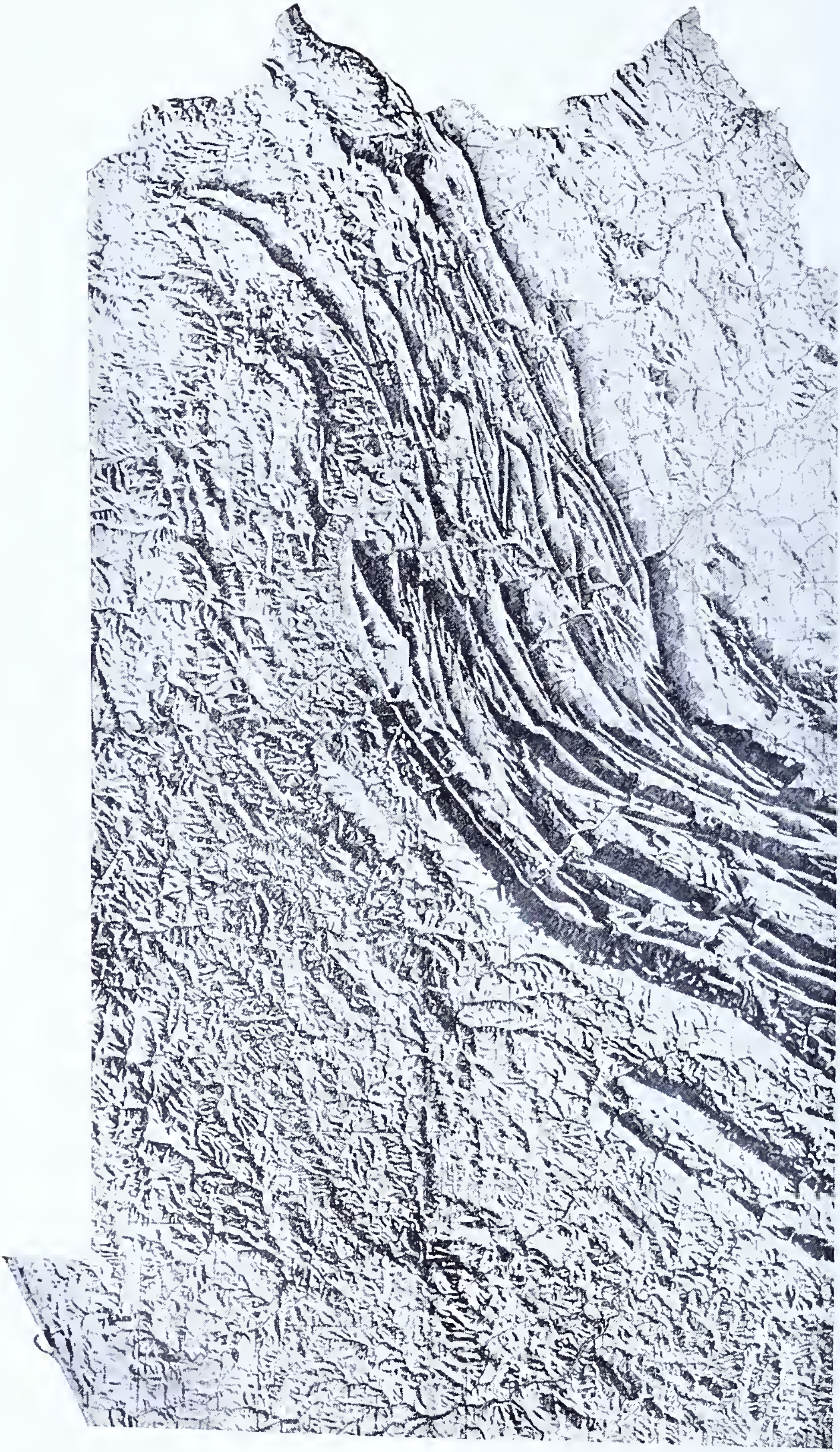

Fig. 1. Relief map of Pennsylvania showing location of Greene County.

GEOLOGY AND MINERAL RESOURCES OF GREENE COUNTY, PENNSYLVANIA

By Ralph W. Stone.

INTRODUCTION.

Because in the not far distant future, Greene County is likely to become a much greater producer of minerals than at present, and to prepare the people for that event, this report was undertaken. Here is an entire county underlain by the great Pittsburgh Coal bed which as yet is mined at only a few points on the edge. Here are oil fields that have not been exhausted by 40 years of drilling, and gas fields that are constantly being extended. Other lesser resources can be developed when transportation is easier.

For those who now own the land and for those who contemplate purchasing, a compendium of information on the subjects here discussed is highly desirable. Previous accounts of the area have been written, become out of date, and gone out of print. The latest description of the area is 20 years old, antique to the men who were born in the present century.

The principal published reports are Report K, Second Geological Survey of Pennsylvania, 1876, by J. J. Stevenson; the Masontown-Uniontown folio (No. 82, 1902, by M. R. Campbell), Waynesburg folio No. 121, 1905 by R. W. Stone), and Rogersville folio (No. 146, 1907, by F. G. Clapp), of the Geologic Atlas of the United States; a brief paper ''Oil and gas fields of eastern Greene County, Pa.'' by R. W. Stone, in Bulletin No. 225, United States Geological Survey, 1904, pages 396-412; a paper entitled ''The Nineveh and Gordon oil sands in western Greene County, Pa., by F. G. Clapp, in Bulletin No. 285, United States Geological Survey, 1906, pages 362-366; Oil and gas fields of Greene Co., Pa., by R. W. Stone and F. G. Clapp, Bulletin No. 304, United States Geological Survey, 1907; and the logs of some Greene County wells in West Virginia Geological Survey, Vol. 1 (A), 1904, pages 121-133, by I. C. White.

For the material in this report the writer has drawn on the earlier reports, on other printed sources of information, as Coal Analyses by U. S. Bureau of Mines, published by the Pennsylvania Topographic and Geologic Survey as Bulletin M6, part IV, 1925, and on his personal observation.

Location and area. Greene County occupies the southwest corner of the Commonwealth of Pennsylvania. It is bounded on the south and west by West Virginia, on the north by Washington County, and on the east it terminates at Monongahela River, the boundary of Fayette County. It has an area of 574 square miles or 367,360 acres.

Field Work. The writer first visited Greene County in 1902. Two months spent in mapping the geology of the Waynesburg quadrangle acquainted him with the eastern half of the county. In November, 1925, September 1926, and June 1928, the writer looked over the whole county in a reconnaissance way to learn of the present mineral developments. The work in 1902 was done with horse and buggy.

What was then an all day's drive is now accomplished by automobile between breakfast and bank opening hour. The construction of hard roads not only makes it possible to go a longer distance in a given length of time, but grading the roads has made more exposures of bed rock accessible to the geologist.

HISTORICAL NOTES.

This is no place to recount the history of Greene County. Books on the subject have been written by Samuel P. Bates and by Rev. William Hanna. It is not amiss however to remind the reader of a few points.

The area now known as Greene County bears little or no evidence of having contained Indian settlements. It may have been a hunting ground or natural game preserve for the aborigines and doubtless was frequented by bear, deer, bison, wild turkey and other game.

Just who was the first settler is a question. It may have been Augustine Dilliner, who, with his wife, settled on the west bank of Monongahela River one mile below the mouth of Cheat River, some time before Braddock's defeat in 1755. Among the first settlers were the Echerline Brothers who established themselves on Dunkard Bottom; Colonel John Minor and Jeremiah Glasgow who cleared land and built homes on Whiteley Creek near Mapletown in 1764; the Swans, Vanmeters, and Hughes on Muddy Creek. The first white child born in Greene County probably saw the light in the log cabin of John Armstrong on Muddy Creek about 1867 and was named Abraham.

It was in the days of the earliest pioneering that Mason and Dixon surveyed the line marking the south boundary of the State. They were stopped by Indians of the Six Nations when they reached Dunkard Creek above Mount Morris in November 1767. Mount Morris had been founded two years earlier. The Indians refused to allow them beyond their warpath on the east bank of the creek. A road now follows the old Indian route. In 1782 Alex. McClean and Joseph Neville continued the line from Dunkard Creek west for "23 miles to a small poplar in the forks of Fish Creek, and from thence extended a meridian of 61 miles 236 perches to the Ohio River." Thus the south and west boundaries of the county were established. This was only 14 years after the area was purchased from the Indians and before it had more than a handful of settlers.

A tract of land which included what is now Greene County was purchased from the Indians by the Penn Proprietaries on the 5th day of November, 1768. For three years thereafter the inhabitants had to go to Carlisle for the transaction of county business.

Greene County was set off from Washington County by an act of the Legislature on the 9th of February 1796, with the following words:

"Section 1. Be it enacted, etc. That all that part of Washington County lying within the limits and bounds hereinafter described shall be, and is hereby erected into a separate county, that is to say beginning at the mouth of Ten Mile Creek, on the Monongahela River, thence up Ten Mile Creek, to the junction of the north and south forks of said creek; thence up said north fork to Colonel William Wallace's Mills (West Bethlehem); thence up a southwesterly direction to the nearest part of the dividing line between the north and south forks of Ten Mile Creek; thence along the top of the said ridge to the ridge which divides the waters of Ten Mile and Wheeling

Creeks, thence a straight line to the head of Enlow's branch of the Wheeling; thence down said branch to the western boundary line of the State; thence south along said line to the southern boundary of the State; thence east along said line to the river Monongahela; and thence down the said river to the place of beginning; to be henceforth known and called by the name of Greene County."

Some dissatisfaction arose as to part of the northern line westward from the divide between Ten Mile and Wheeling Creeks and the Legislature, at its session of 1802, made the following emendation, viz: "That the following alteration shall take place in the line between the counties of Washington and Greene, viz: Beginning at the present line, on the ridge that divides the waters of Ten Mile and Wheeling Creeks, near Jacob Bobbet's; thence a straight line to the head waters of Hunter's fork of Wheeling Creek; and thence down the same to the mouth thereof, where it meets the present county line." This gave to Washington a block of land (in East Finley Township), not material to Greene, but desired by Washington.

Enlows Fork on the old maps is a south flowing stream in the eastern part of what is now West Finley Township. Now it is known as Templeton Fork, from a pioneer settler who owned a tract of land at its mouth. Hunters Fork, the present boundary of the county, unites with Enlows (Templeton) Fork 1¼ miles below Eno to form Wheeling Creek.

Greene County was named in honor of General Nathaniel Greene of the Continental army, and a close friend of General George Washington.

On the 28th of October, 1796, eight months after the county was formed, the Trustees of Greene County purchased from Thomas Slater and uxor "a tract of land called Eden for the purpose of erecting thereon a Court House and Gaol and other public buildings for the use of the county." Eden later was named Waynesburg in honor of General Anthony Wayne. The first brick court house was built in 1800, and the village was incorporated in 1816.

The early settlers came from the east on foot or horseback and reached Monongahela River at the mouth of George Creek opposite Greensboro, or at the mouth of Cheat River, now Point Marion. Hence the first homes in Greene County were cabins built on the bank of the river. Subsequent home seekers made their way up Dunkard, Whiteley, and Tenmile creeks and established themselves along these valleys on the broader terraces. Before 1800 several settlements had been founded, even as far west as Graysville. The increase in population of Greene County may have been retarded after 1820 when the National Pike was completed from Cumberland, Maryland, to Wheeling, West Virginia, for it diverted traffic to the crossing at Brownsville and lessened the stream of emigration across Greene County.

The settlements were built on the valley bottoms or on terraces above the flood plains. Today all but 3 of the 39 post offices are on streams. Wind Ridge in Richhill Township, and Garrison and Ned in Springhill Township are on ridges.

In 1930 the population of Greene County was 41,767, an increase of 10,963 in 10 years. This increase is mostly in four new mining towns, Crucible, Dilliner, Mather and Nemacolin.

The population of boroughs reported by the census of 1930 is as follows:

Carmichaels	708	Greensboro	598	New Freeport	408
Clarksville	457	Jefferson	528	Rices Landing	977
Graysville	240	Mount Morris	318	Waynesburg	4915

The four coal mining towns, not separately reported by the census, are said by the Waynesburg Chamber of Commerce to be approximately as listed: Crucible, 1800, Bobtown, 1400, Mather, 2000 Nemacolin, 2700.

Rural settlements whose size changes little were not separately reported by the census of 1930 but were recorded in 1920 as follows:

Aleppo	97	Jollytown	75	Poland	219
Brave	476	Khedive	110	Rogersville	415
Bristoria	143	McCracken	114	Ruff Creek	84
Davistown	95	Mapletown	134	Rutan	60
Deep Valley	113	Nineveh	248	Spragg	110
Dunkard	213	Oak Forest	86	Whiteley	115
Garrison	63	Pine Bank	215	Wind Ridge	163

Waynesburg, the county seat, situated not far from the center of the county, has by reason of Waynesburg College, for many years been the local center of culture. Also it has been the mecca to which farmers moved when made financially independent by the production of gas or oil on their lands. The erection of a modern hotel in 1927, and the improvement of highways in all directions have been of great benefit to this village.

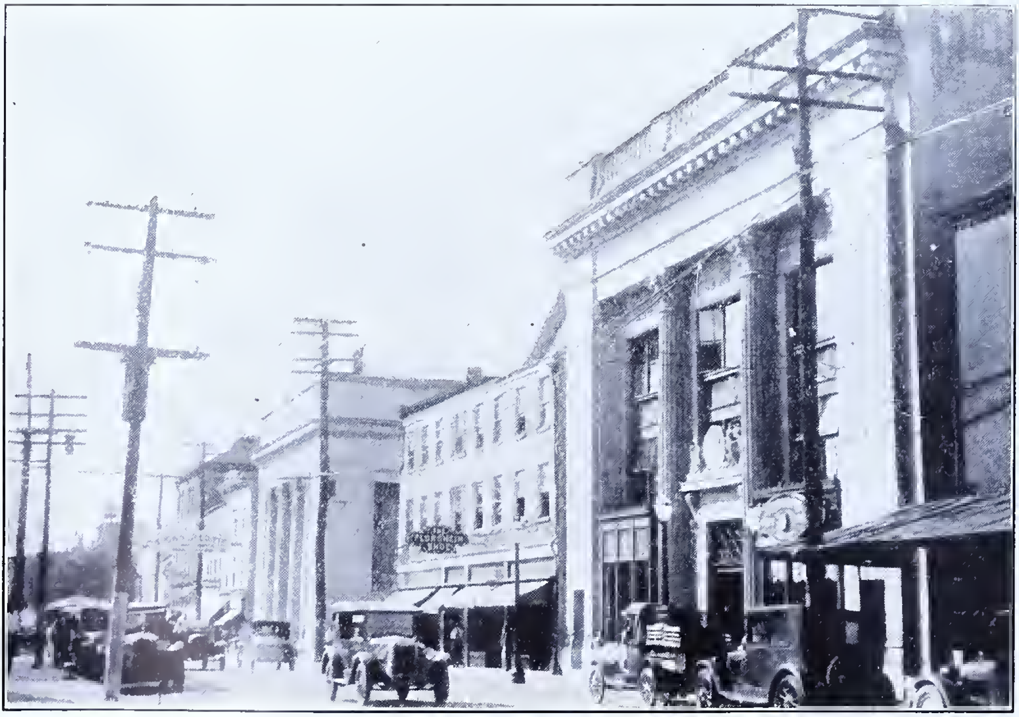

Fig. 2. Business street in Waynesburg opposite the Court House in 1928.

Mather, a coal-mining town on Tenmile Creek, is next to Waynesburg in population, and far superior to most strictly mining towns in its physical appearance.

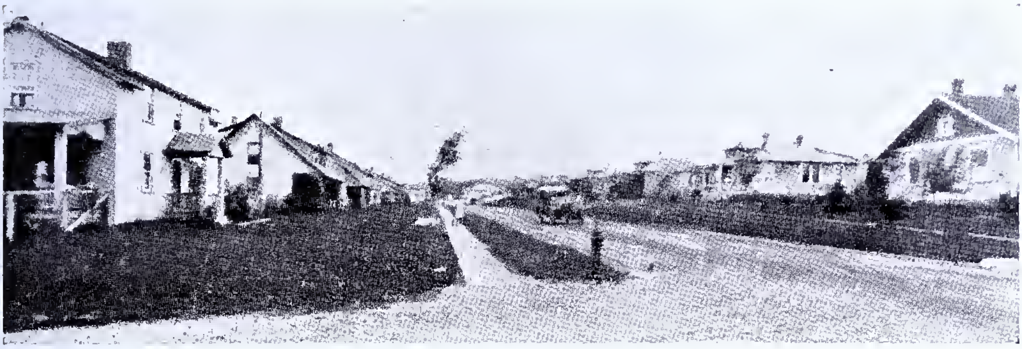

Fig. 3. Street scene in Mather, a coal-mining town.

Crucible and Nemacolin are sightly towns perched on the bluff 200-300 feet above the Monongahela, and their population of about 2,500 each is supported by mining the Pittsburgh coal.

Origin of names. Greene County was named for General Nathaniel Greene, a great leader of the Continental Army. Half of the townships seem to have been named for men illustrious in our early political history. These are Washington, Jefferson, Franklin, Jackson, Perry, Greene, Morris, and Morgan. Cumberland Township may have been named for the Duke of Cumberland, or for the county in England. Monongahela took its name from the river, and Dunkard from the German Baptists who settled there. Richhill and Springhill may signify fertility and abundance of springs in hilly land, Center its approximate location. Aleppo may be of Biblical origin for the town north of Palestine, and Gilmore and Whiteley may be the names of early settlers. Mapletown was started by the Mapel family, Davistown, Clarksville and Graysville by the Davis, Clark and Gray families. Other family names of settlements are Dilliner, Spragg, Fordyce, Gump, Cummins, Lippincott, McCracken, Durbin, Rutan. Family names also are given to runs and creeks, as Fordyce, Craynes, Grimes, Purman, Wisecarver. Other stream names are descriptive, as Muddy, Glade, Laurel, Meadow, Wagonroad, Blockhouse. Tenmile Creek was so named because it empties into Monongahela River just 10 miles above Brownsville. Nineveh doubtless was named for the ancient Assyrian capital. Deep Valley is descriptive; New Freeport, founded by W. P. Hoskinson in 1849, of course means a new free trading point. Jollytown was named after an early settler, Titus Jolley. The writer has seen an agreement of sale and a note made in 1834 in which Mr. Jolley spelled his name with an e. Mount Morris is at the foot of a steep hill and was named for Levi Morris, a pioneer settler. It was founded in 1765.

CLIMATE.

The climate of Greene County is healthful. The summers are rather short and pleasant, and the winters are cold, but severe cold spells are of short duration. The temperature through the winter months

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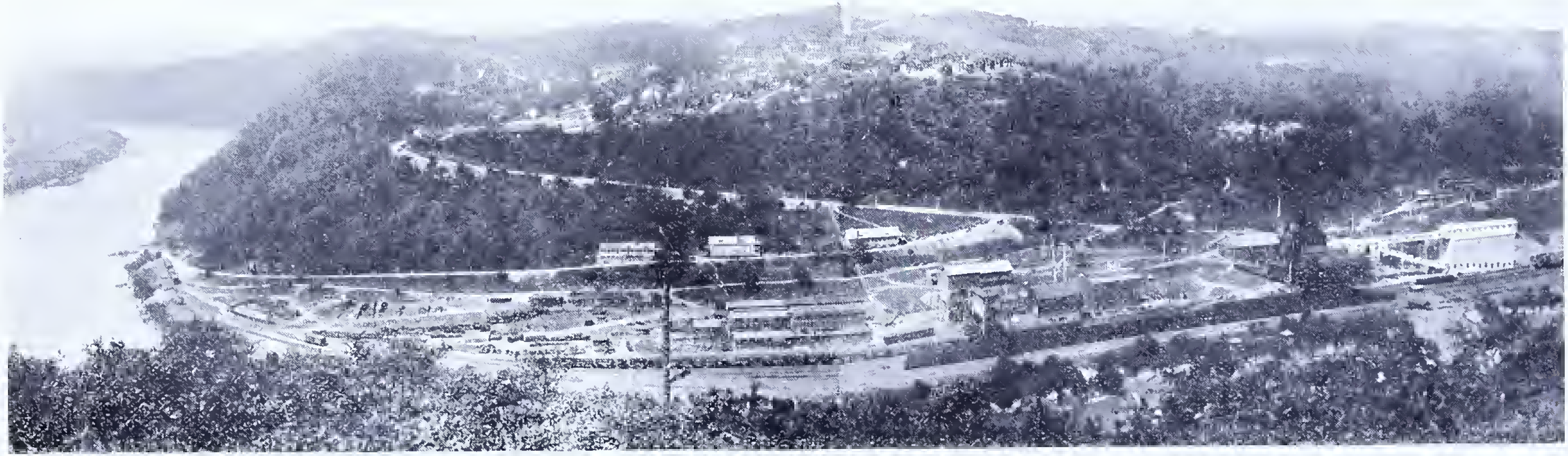

Fig. 4. Nemacolin, seen from across Monongahela River.

(December, January and February) falls below zero occasionally. The records of the Weather Bureau station at Aleppo give the annual mean temperature as 51.2° F. The winter mean is 30.5° F. and the summer mean is 69.9° F. The highest recorded temperature was 100° F. in August, and the lowest was —27° F. in January. There is considerable snow during the winter, with a yearly average fall of 34.9 inches. The date of the latest recorded killing frost in the spring is June 10 and that of the earliest in the fall is September 10. The average dates of the last killing frost in spring and the first in fall are May 14 and October 3, respectively. This gives a growing season of 142 days.

The average annual precipitation at Aleppo is 40.68 inches and is fairly well distributed throughout the year. At Uniontown, Fayette County, which is about 16 miles from the east side of Greene County, the length of growing season is 164 days and the average rainfall 47.29 inches, the rainfall being heaviest in the spring and summer and lightest in the fall. The total rainfall at Aleppo for the driest year on record was 35.58 inches, and for the wettest year, 54.53 inches.

The climatic data in the tables following, compiled from the records of the Weather Bureau stations at Aleppo, Greene County, and Uniontown, Fayette County, give more detailed information.

Normal monthly, seasonal, and annual temperature and precipitation at Aleppo.

(Elevation, 1,135 feet.)

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1910)	Total amount for the wettest year (1907)	Snow, average depth
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December	31.9	70	—14	3.31	2.40	3.25	6.5
January	30.7	75	—27	3.99	6.85	7.03	12.3
February	28.8	70	—20	2.44	3.87	1.99	8.2
Winter	30.5	75	—27	9.65	13.12	12.27	27.0
March	42.6	84	—3	4.05	.25	8.17	4.9
April	49.5	90	12	3.62	3.10	3.34	1.4
May	61.4	94	23	3.66	4.18	3.60	.0
Spring	51.2	94	—3	11.33	7.53	15.11	6.3
June	67.3	94	33	3.93	2.54	3.90	.0
July	72.1	98	41	4.97	5.15	9.46	.0
August	70.2	100	39	3.15	1.12	3.63	.0
Summer	69.9	100	33	12.05	8.81	16.99	.0
September	65.2	97	28	2.87	2.52	3.79	.0
October	53.4	89	17	2.70	1.80	3.64	T.
November	41.2	78	6	2.08	1.80	2.73	1.6
Fall	53.3	97	6	7.65	6.12	10.16	1.6
Year	51.2	100	—27	40.68	35.58	54.53	34.9

---

[1] Soil Survey of Greene County, Pennsylvania: Field Operations of Bureau of Soils, U. S. Dept. of Agriculture, 1921, p. 1254-55, 1925.

Normal monthly, seasonal, and annual temperature and precipitation at Uniontown, Fayette County.

(Elevation, 999 feet.)

Month	Temperature			Precipitation.		
	Mean	Absolute maximum	Absolute minimum	Mean.	Total amount for the driest year (1904).	Total amount for the wettest year (1890).
	°F.	°F.	°F.	Inches.	Inches.	Inches.
December	34.9	73	—13	3.65	1.89	6.84
January	32.3	80	—19	3.93	2.83	6.10
February	31.4	77	—22	3.12	2.61	4.73
Winter	32.9	80	—22	10.70	7.33	17.67
March	41.1	84	—10	4.27	4.32	6.27
April	50.8	93	15	3.74	3.72	3.90
May	62.0	96	28	4.20	3.64	8.03
Spring	51.3	96	—10	12.21	11.68	18.20
June	70.0	101	37	4.82	2.52	4.33
July	73.0	98	44	5.40	3.29	5.65
August	71.6	101	43	4.55	3.61	8.44
Summer	71.5	101	37	14.77	9.42	18.42
September	66.1	94	32	3.26	1.99	6.73
October	54.3	92	20	3.11	1.27	7.41
November	43.3	78	13	3.24	.25	2.25
Fall	54.6	94	13	9.61	3.51	16.39
Year	52.6	101	—22	47.29	31.94	70.68

AGRICULTURE.

In contrast with the early days when wheat was ground into flour, corn and rye converted into whiskey, and the surplus of these products was rafted down the Monongahela and Ohio to markets on the Mississippi, the prevailing agricultural occupation in Greene County today is raising live stock. Sheep are more numerous here than in any other county except Washington, numbering over 100,000. The wool goes to Baltimore and the mutton on the hoof to Pittsburgh.

Beef cattle occupy second position among live stock, and are raised or fattened for the Pittsburgh market. Much fewer dairy cattle are kept although the county is well suited to dairying. The objection to dairying is the bad condition of country roads in winter and spring. As the writer sees it, a hilly country like most of Greene County is much better adapted to raising live stock and hay than to crops which require frequent cultivation of the soil. Soil creep is conspicuous on steep hillsides that are or were cultivated and is a sign that those acres were best left in timber or pasture. The acreage devoted to wheat and corn has decreased about 50 per cent in 50 years, oats have held rather steady between 13,000 and 18,000 acres, but the land in hay and forage has risen from 28,000 acres in 1880 to 50,000 acres now and the yield from about 2/3 ton per acre to 1½ tons.

These hills are well adapted also to orchards but the raising of fruit on a commercial scale has received little attention.

The soils in Greene County may be classified, on the basis of the origin, into three broad groups: (1) upland residual soils, (2) terrace or old alluvial soils, and (3) first-bottom or recent alluvial soils. The upland residual soils cover about 89 per cent of the county.

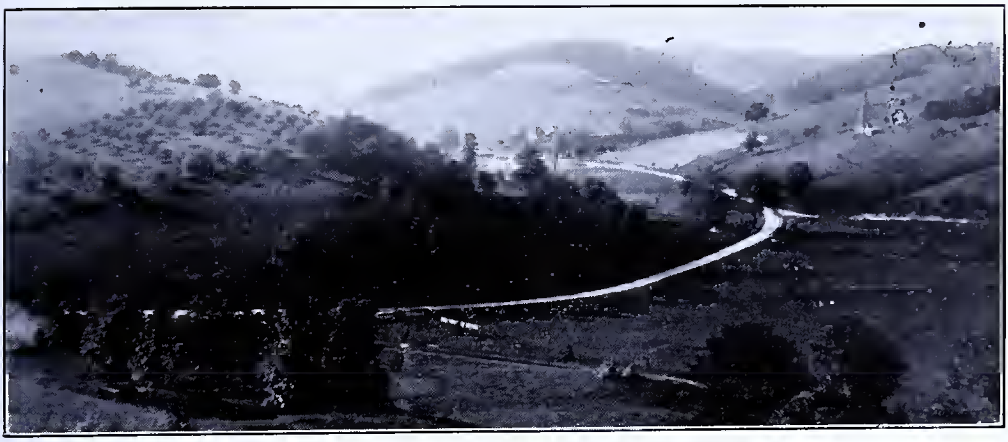

Fig. 5. Typical topography. Dyers Fork, 2 miles north of Kirby on the Waynesburg-Mt. Morris road.

WOODLANDS.

A vast forest originally covered Greene County. Hardwoods predominated throughout most of the area, with pine, spruce and hemlocks on the rougher land along Monongahela River and the larger creeks. Long since, the greater part of the forest was cut to make the land available for tillage or pasture, and only about 15 per cent of the original heavy hardwood stand remains. The native timber today is mostly on steep hill slopes, crests of ridges, the bluffs along the larger streams, and in sharp-cut ravines. It includes white oak, red oak, post oak, chestnut oak, hickory, ash, maple, elm, walnut, tulip poplar, black gum, locust, dogwood, and other species.

In recent years private planting of forest trees has been undertaken by individuals and companies. Reforestation, begun in a small way, is likely to increase as the large coal companies realize the advantage of growing the wood required in and about the mines. According to the Pennsylvania Department of Forests and Waters the number of trees set out in Greene County in recent years is as follows:

Forest trees planted in Greene County.

1917	800	1924	500
1918	1,000	1925	68,000
1919	0	1926	76,300
1920	0	1927	151,300
1921	125	1928	45,500
1922	75,000	1929	35,000
1923	3,100	1930	31,000

Planting in 1926 was as follows: Buckeye Coal Company in Cumberland Township, 20,000 each of white pine, Scotch pine, and white ash; F. B. Jones in Wayne Township, 5,000 each of Scotch pine, red pine, and Norway spruce; Katherine Blackshere in Monongahela Township, 1,000 shortleaf pine; and T. F. Ealy of Time School, Morris Township, 200 white pine and 100 Scotch pine.

In 1925 the Buckeye Coal Company planted 25,000 white pine, 30,000 Norway spruce, 10,000 white spruce, and 2,500 red pine; and the Mather collieries planted 500 pines of three varieties.

As the other large coal companies experience greater difficulty in getting suitable mine timber at a reasonable cost, they also are likely to begin growing timber on their holdings.

TRANSPORTATION.

Greene County is a bit off the main routes of travel. As there are some advantages in having one's residence some little distance from a railroad or from a main highway like the William Penn and Lincoln, so there may be some slight advantage to a county if it is not crossed by a popular transportation system. Its residents are not so likely to be bothered by tramps, at least.

The National Old Trails highway from Baltimore through Cumberland to the west passes to the north of Greene County through Uniontown and Washington. Before this National Pike was built the main route from Baltimore to the west crossed Monongahela River at Greensboro, followed up Whiteley Creek to its head, and thence down Fish Creek through Deep Valley.

Monongahela River runs counter to the movement of early settlement and in Colonial days must have been more of an impediment than an aid to progress. Since the river has been dammed and slack water navigation made available up to Fairmont, W. Va., it has made possible the opening of coal mines along its banks and has furnished a cheap way of moving coal, sand, gravel, and other bulky products. The freight passing up and down the river through the lock at Rices Landing amounts to millions of tons annually. Were it not for these locks and dams several of the larger coal mines along the river bank in Greene County would not have been opened, for until recent years the river afforded the only means of moving the coal.

The freight on the Greene County stretch of the river is reported by U. S. Engineer Officer, Pittsburgh.

Freight passing Lock No. 6, Monongahela River, in 1929.

Commodity	Tonnage Up	Down	Total
Cement	4,995	50	5,045
Coal	785	9,570,164	9,570,949
Coke		400	400
Iron and steel (unmanufactured)		350	350
Iron and steel (rolled)	625	955	1,580
Lumber	225	800	1,025
Logs	4,433		4,433
Gasoline	10,500		10,500
Sand and gravel	22,600	19,175	41,775
Stone		3,400	3,400
Other commodities	955	550	1,505
Total	45,118	9,595,844	9,640,962

Until 1918 the only railroad in Greene County was the Waynesburg & Washington Railroad, a narrow gauge uniting the two places. It was built in 1877 and has transported many thousands of tons of goods from Pittsburgh to the county seat in spite of the necessity for rehandling at Washington. In 1919 another branch of the Pennsylvania System was built from Millsboro up South Fork of Tenmile Creek to Mather opposite Jefferson for handling the output of several new coal mines. In 1926 the tracks ended under the highway on the west bank of Tenmile Creek half a mile southwest of Mather, but surveys were being made for an extension of this railroad to Waynesburg, and clearing the right of way for this extension was begun June 18, 1928. This Monongahela Railway was completed to Waynesburg and placed in operation January 1, 1930.

The Pennsylvania Railroad also built a single track line along the west bank of Monongahela River from the mouth of Tenmile Creek through Rices Landing and Crucible to Nemacolin in 1918. The northbound traffic on the railroad is coal from Nemacolin and Crucible and southbound traffic is construction material and general supplies.

The Monongahela Railway follows the Greene County side of Monongahela River about 4 miles from the West Virginia line to Poland at the mouth of Dunkard Creek where it crosses to the east bank of the river. This also is very largely a coal-carrying railroad. It was built from Masontown to Martin in 1903, and the extension from Martin up the river on the Greene County side to the West Virginia line was placed in operation November 2, 1914.

A branch of this railroad on Dunkard Creek to handle coal from a mine being opened for Jones & Laughlin Company was built in 1927 and in June 1928 a new coal mining town, Bobtown, had 354 houses, 1,200 population and two large mine entries.

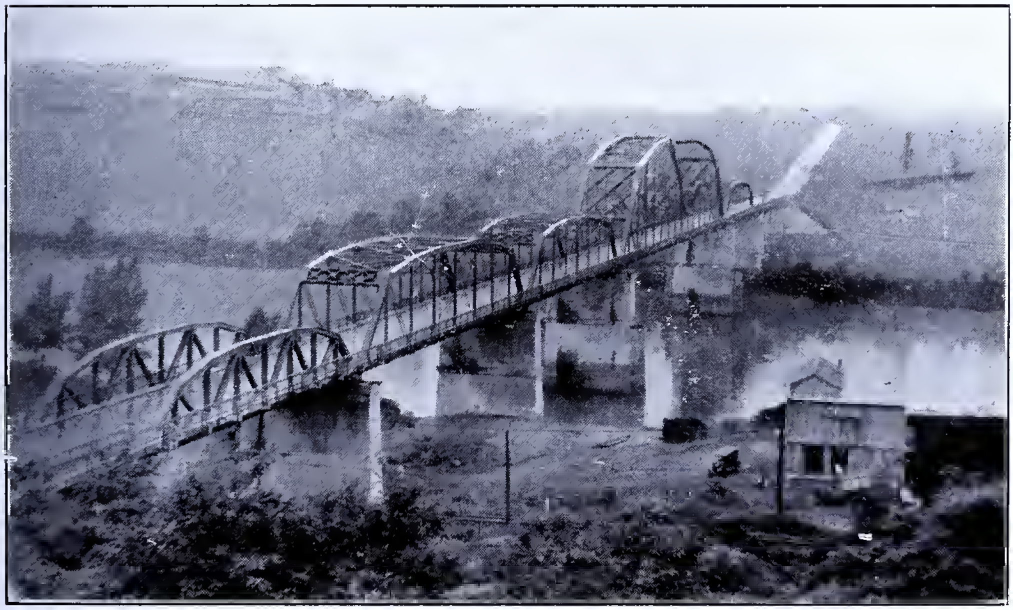

Fig. 6. Bridge over Monongahela River between Masontown and Carmichaels.

The Scotts Run branch of the Monongahela Railway from Randall, West Virginia, enters Greene County near Blacksville, follows up Dunkard Creek, and terminates at Brave, a rural community on Pennsylvania Fork of Dunkard Creek just inside the southern boundary of Wayne Township. A considerable part of the freight handled by this road is iron pipe for casing oil and gas wells, outgoing logs and incoming coal and lumber.

There are no electric railroads in the county. A road bed was graded from Blacksville to Waynesburg via Roberts Run and Smith Creek in 1911-12 but the project was abandoned before bridges had been built or rails laid.

Modern roads of the State Highway system reach Waynesburg from north, south, and east. The through route from Erie to Clarksburg, West Virginia, is completed across Greene County with either concrete or bituminous surface-treated macadam and oil-bound broken stone. The section from Waynesburg to Mount Morris was opened and dedicated on Armistice Day, November 11, 1925. A similar highway leaving the National Highway near Brownsville enters Greene County at the northeast corner and extends through Jefferson, Waynesburg, and Rogersville to Holbrook and Rutan. Automobile busses transport passengers on regular schedules over these roads from Waynesburg to Washington and Morgantown, and much freight is hauled over them by automobile to facilitate quick delivery or to avoid the rehandling at Washington of freight shipped in and out of Waynesburg on the narrow guage railroad. Waynesburg is also on the proposed new east-west route between Uniontown and Wheeling, which crosses the Monongahela on a new bridge at Masontown. An improved hard road on this route is completed across the county from the river to Graysville.

The county and township roads, formerly common dirt construction, are gradually being repaired or reconstructed with crushed stone. During the wet spring and fall weeks some of the dirt roads are almost impassable by automobile unless one is experienced in driving over them, and some parts of the county are then difficult of access; but in summer all roads are easily passable except those which ascend ridges with a grade of 200 feet in a quarter of a mile or less.

TOPOGRAPHY OF THE COUNTY.

DRAINAGE.

The divide between Ohio and Monongahela River drainage crosses Greene County from north to south. Hunters and Dunkard forks of Wheeling Creek and Pennsylvania Fork of Fish Creek are the main streams flowing west to the Ohio. A circuitous line is the divide, following the ridgetops from the south boundary of Springhill Township through Garrison half a mile west of Ashtree to Nettle Hill, halfway between White Cottage and Delphene, and thence to within half a mile of Bristoria, circling far to the west of Graysville, and then doubling back, passing half a mile east of Time and thence to the Washington County line. Bates Fork, Browns Creek, Grays Fork, and McCourtney Run heading against the east side of this divide unite to form the South Fork of Tenmile Creek. Blockhouse Run heading at Nettle Hill is the farthest head of Dunkard Creek in Greene County and carries some of the run off from Jackson and Gilmore townships to the Monongahela.

The principal tributaries of Monongahela River in the county are South Fork of Tenmile Creek, and Muddy Run, Whiteley and Dunkard creeks. Monongahela River itself forms the eastern boundary of the county from the West Virginia line on the south to the Washington County boundary at Millsboro on the north. The river receives the drainage of about three-quarters of Greene County.

As the surface has been cleared of a large amount of its original covering of timber, and the slopes generally are steep, all the streams are subject to floods and at such times carry a large quantity of water. Crops growing on flood plains are in danger of being damaged or com-

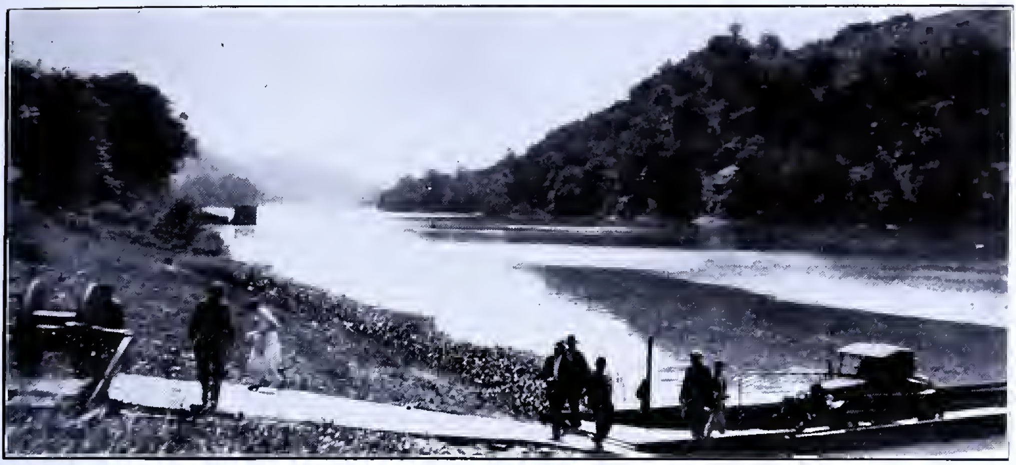

Fig. 7. Monongahela River at Point Marion. Greene County on the right.

pletely destroyed by high water. These high stages appear quickly, but are of short duration. During the droughts of summer, all but the largest streams become entirely dry. There are no natural lakes or ponds in the county. The grade of the streams is so gentle and water so scanty in summer that there is no water power to develop for commercial purposes and there are none of the old grist mills with their dams and ponds that are so common in some other regions.

The Monongahela itself originally was an inconsequential stream, easily forded in its low stages, too wide and shallow for development of water power by individual initiative. In 1840, however, private enterprise began building a series of dams and locks in this river. This was continued by the U. S. Government and slack water navigation is now available from Pittsburgh to Fairmont, West Virginia.

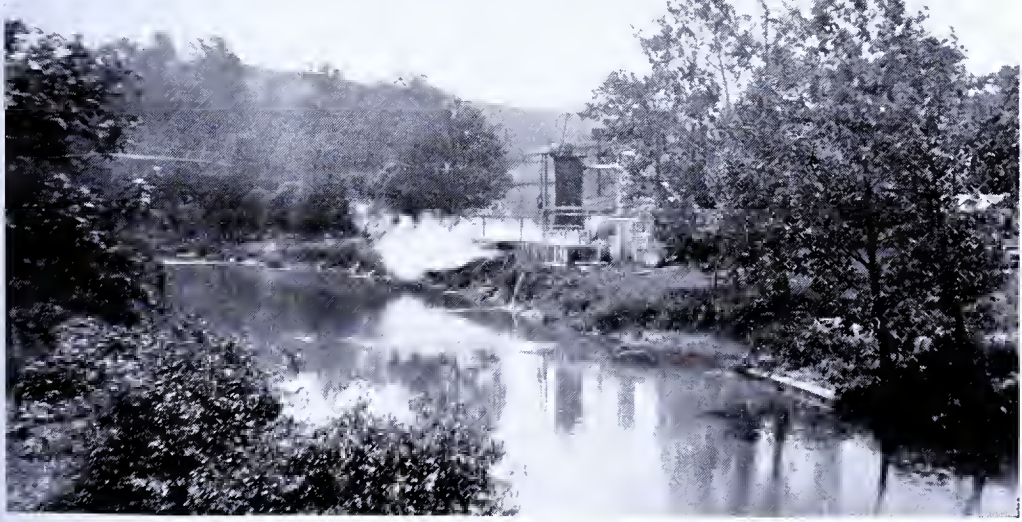

Fig. 8. South Fork of Tenmile Creek at Carnegie compression station east of Waynesburg.

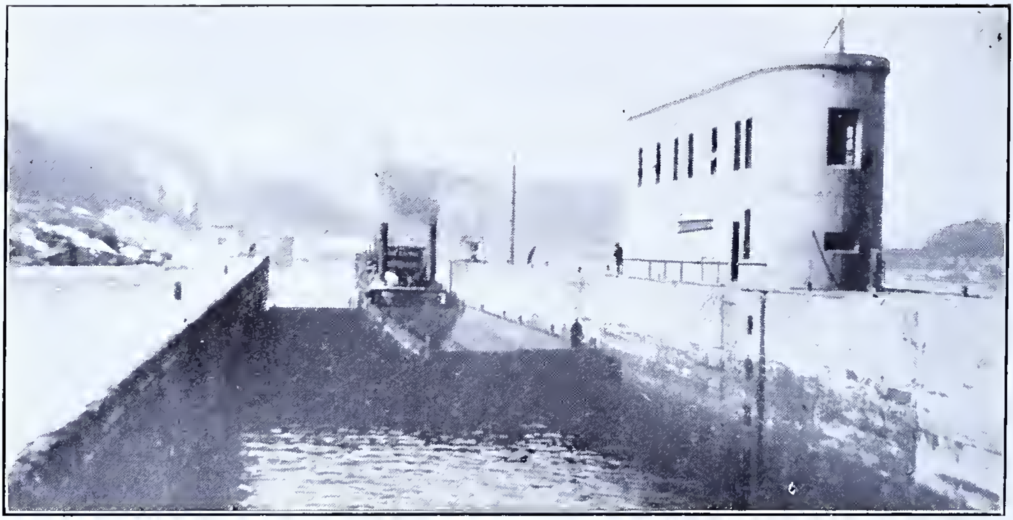

Fig. 9. Lock No. 6 at Rices Landing passing coal barges.

The altitude of the surface of the water in the various pools is as follows:

Altitude of surface of Monongahela River between Pittsburgh and Morgantown.

	Feet above tide
Pool of Davis Island dam, Pittsburgh	703.00
Pool No. 1	707.40
Pool No. 2	715.10
Pool No. 3	723.10
Pool No. 4	733.48
Pool No. 5	746.41
Pool No. 6	760.15
Pool No. 7	769.99
Pool No. 8	780.80
Pool No. 9	793.40

Dam No. 5 below Fredericktown makes the first pool in Greene County. The first dam in Greene County is No. 6 at Rices Landing. Dam No. 7 formerly was 14 miles farther up the river 1½ miles above Grays Landing, but has been abandoned and a new dam and lock built at the mouth of George Creek above Greensboro. Dam No. 8 was at the mouth of Dunkard Creek, but has been removed and a new one built at the State line.

Asymmetrical drainage. A peculiar feature of the drainage of Greene County and of several other counties in southwestern Pennsylvania is that the main east-and-west-flowing streams are nowhere near the middle of their basins. In general the tributaries on the north are much longer than those on the south, and the north slope being shorter is steeper. The main streams flowing north and south are much more symmetrical. In the basin of Ruff Creek, northern Greene County, for instance, Boyd and Cranes runs on the north head at the divide 4 miles away, while on the south side the laterals are scarcely more than a mile long. This relation is very pronounced in the valley of Whiteley Creek, where, in the eastern part of Whiteley Township the divide on the north is distant from the creek 4½ miles, and that on the south 1¼ miles. This characteristic is less conspicuous in the South Fork of Tenmile Creek about Waynesburg, where the long, straight course of Smith Creek, flowing from the south, is an exception. The asymmetry of South Fork is plain west of Rogersville and on Grays Fork, and on all the main west-flowing streams in the west end of the county. Enlow Fork, Crabapple Creek, North Fork of Wheeling Creek, and Pennsylvania Fork of Fish Creek crowd the south side of their basins very noticeably.

This asymmetrical arrangement of the drainage can not be ascribed to the present structure of the rocks, because it disregards anticlines and synclines alike. South Fork of Tenmile Creek heads on the Washington anticline, crosses the Nineveh syncline, Amity anticline, Waynesburg syncline, and Bellevernon anticline, and then swinging to the northeast recrosses the same axis twice in the vicinity of Clarksville. Dunkard Creek in its course along the State line passes across several minor structural axes.

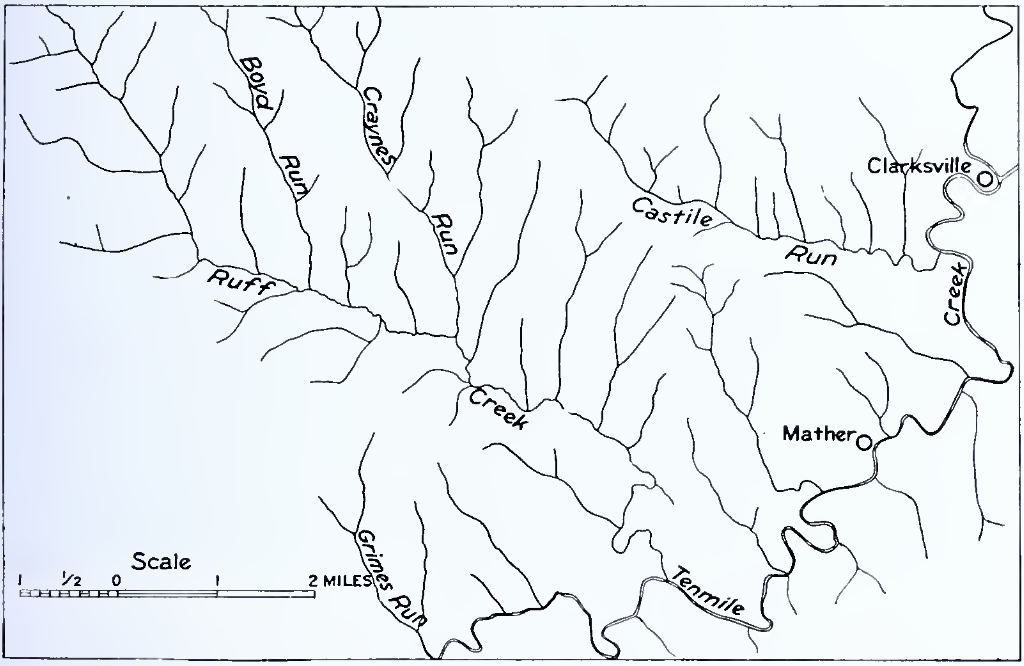

Fig. 10. Asymmetrical drainage in Greene County.

So far as the character of the rocks is concerned the tributaries on both sides of the streams should be of equal length. The underlying rocks for the most part are easily eroded shales and platy sandstones. The few limestones in the Dunkard series, which makes most of the surface, are thin and topographically ineffectual. Massive sandstones are rare and, although they make cliffs and benches in some places, are not the cause of any pronounced topographic features. There seems, therefore, to be nothing underground to explain the lop-sided basins.

The only cause for the great difference in the length of the streams on the north and south sides of east-west basins, and so for the rate of erosion, so far the writer has observed, is the relation of the sun to the earth's surface at the beginning and end of winter. October and November snow falls usually do not remain long on the ground. The southern position of the sun causes the snow on south-facing slopes to melt quickly while on northern slopes that get less direct rays of the sun and are in shadow part of the day the snow lingers for several days. The writer observed that the snow which fell at Waynesburg October 27, 1925 was gone from the southern slopes in two days, but remained on some northern slopes four or five days and in particularly shaded spots for a week. As the snow was equally distributed, this means that the snow water actually ran off from the south slopes and with volume and velocity sufficient to do some erosion. On the other hand, the snow on the north slopes melted so slowly that the water merely trickled away with little or no erosive effect.

These conditions repeated several times every fall and spring must in the course of a few thousand years lengthen the northern tributaries much more than those flowing from the south. Only in comparatively soft and easily eroded rocks could the effect become strikingly noticeable in the time that has passed since the uplift that followed the retreat of the first continental glacier. The absence of well developed asymmetrical tributaries on the two sides of east-and-west-flowing streams in other parts of the State may be explained by the greater hardness of the rocks which has retarded erosion.

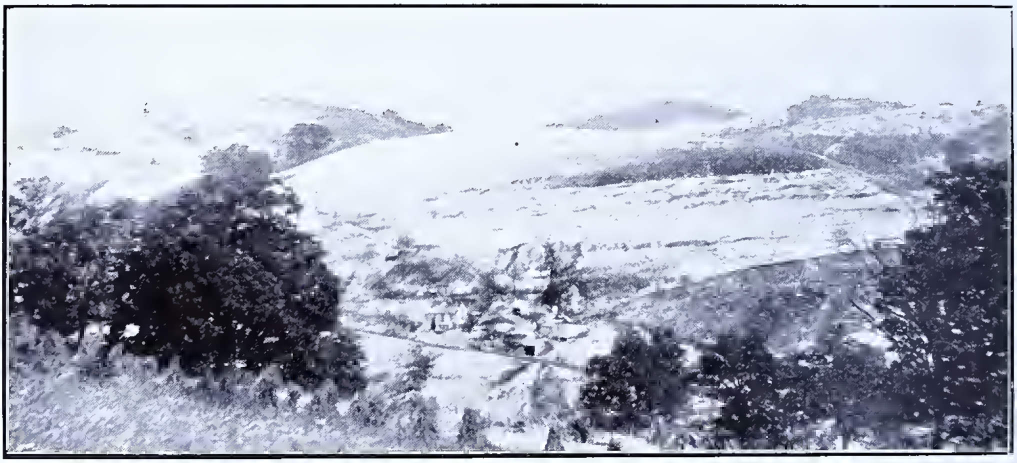

Fig. 11. Topography typical of the Greene group. Purman Run seen from near Waynesburg College, October 29, 1925 after a snow storm.

LAND FORMS.

Whether seeing the surface of Greene County as depicted on topographic maps or by actually crossing it, one is impressed by the fact that it is hilly country. There are few broad flat areas either in valley bottoms or on hilltops. It is all slope, and for the most part rather steep slopes. The whole area is intricately and deeply dissected by streams, the valley bottoms are narrow, as are also the ridge tops. Elevations range from 750 feet on Monongahela River and 850 feet on the streams crossing the western boundary to 1660 feet, the highest point on the Monongahela-Ohio divide. The divide is in the western part of the county and along it there are many hilltops over 1550 feet in elevation. From the divide eastward there is a general slope or decrease in elevation of the ridge crests to about 1300 feet near Monongahela River. Differences in elevation of 500 feet within half a mile occur just below the mouth of Dunkard Creek on Monongahela River and at Eno on the north boundary of Richhill Township. Hills rising 400 feet in half a mile are common.

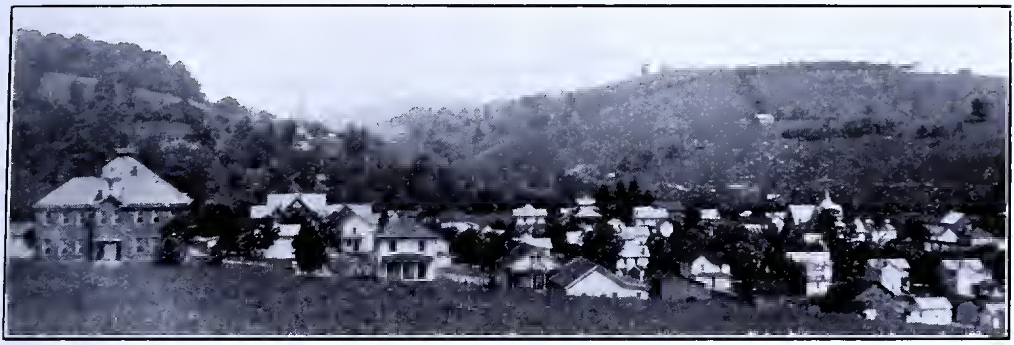

Fig. 12. Typical narrow valley at Rogersville.

Aside from the very pronounced hilliness, particularly of the western half of the county, the most striking feature of the land forms is the flat land between Jefferson and Rices Landing and around Carmichaels. The casual traveler, I fancy, would not notice these areas. The land north and west of Dry Tavern is merely meadows and not so very flat at that, and as for the vicinity of Carmichaels, my own feeling was "Well, here is the best-looking farm land I have seen anywhere in the county." In other words the topography is not likely to be remarked as strikingly different unless one is studying the subject. On a geologic map, however, which shows by different color the unconsolidated stream deposits in contrast with the hard rocks, these areas are conspicuous. They are definitely related to the channel of Monongahela River, seeming to be loops with both ends on the present course. Probably not all the inhabitants of Carmichaels realize that their village is in an abandoned channel of Monongahela River, yet this is an easily demonstrable fact.

Most people who have given any thought to the processes of erosion know that the surface of the earth has not always been as it is now. Running water is constantly tending to move particles of the earth's surface from higher to lower levels, from the hills to the sea, to reduce the surface to a common level. In the course of time, streams deepen and widen their valleys, and may even shift their courses. Monongahela River is now flowing in a steep-walled trench 150 feet deep. That it has not always done so is apparent from the topography of eastern Greene County. As shown by the accompanying figure the river from Dunkard Creek to Muddy Run has deserted a former broadly meandering course for a direct route. The old channel is 140 to 150 feet above the present water level and is marked by rock cut terraces covered with alluvium and by wide valleys with disproportionately small streams. The river shifted its course because the old channel became silted up in places and the water found a lower course elsewhere. This silting up of the channel, to a depth of 100 feet in places, probably was caused by some obstruction during the Glacial period, maybe by the silting up of Allegheny River at Pittsburgh, which ponded the Monongahela. This was so many thousands of years ago that the river has had time since then to cut its channel down 150 feet in hard rock. This distance is easily measured at the places where the present course cuts directly across bows in the original course of the river.

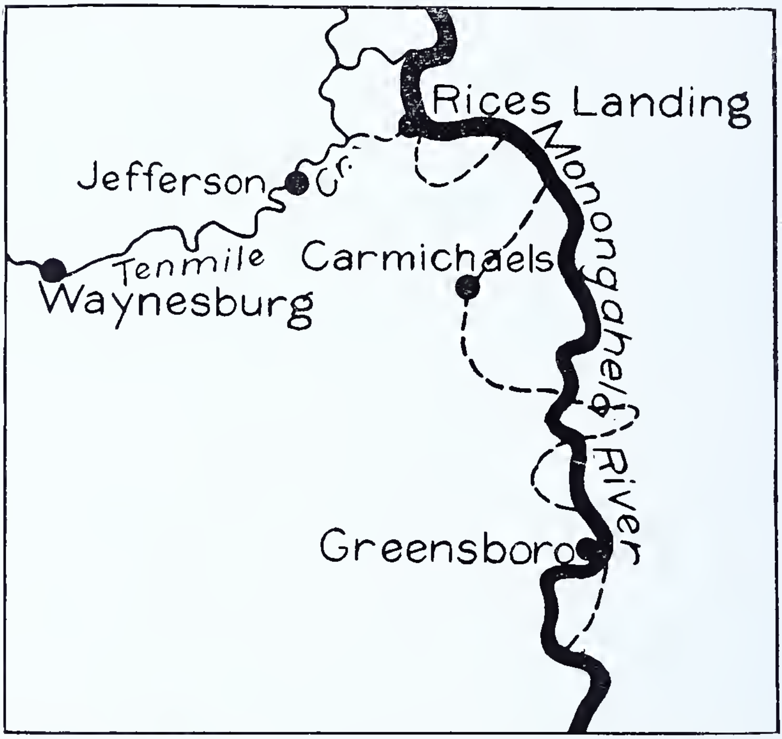

Fig. 13. Present and former course of Monongahela River.

The first digression of the channel below Dilliner is that from the mouth of Dunkard Creek to Greensboro. The river formerly pursued a direct course from Dam No. 8 to New Geneva where now there is a road over a broad gently sloping upland.

From Greensboro to Grays Landing the old course was across the broad fields north of Mapletown, and from Grays Landing the original river described a graceful loop or oxbow around Masontown, back to its present course at Hatfield Ferry and thence west up what is now the valley of Little Whiteley Creek to Carmichaels and on down Muddy Run to its mouth. Whether the old stream swung south at Crucible and thence west to the present valley of the South Fork of Tenmile Creek and down it to Millsboro, or had its present course and South Fork flowed east from Jefferson to Crucible is a question. Of course, the present streams in deepening their channels, like Muddy Run below Carmichaels, and Tenmile Creek in its lower course, have trenched through or almost completely removed all the alluvium that originally filled the former channel of the Monongahela.

SURFACE ROCKS.

The rocks in Greene County are all in layers or beds ranging from a fraction of an inch to many feet thick and for the most part lying nearly horizontal. These rocks are made of sand, mud, and limy material that was laid down in water; therefore they are called sedimentary rocks. Three principal kinds of sedimentary rocks occur here, sandstone, shale, and limestone. Sand packed together and hardened makes sandstone, mud makes shale, and limy ooze makes limestone.

This sand and mud derived from the disintegration or solution of rocks elsewhere, from the remains or products of animals or plants, or from chemical action was laid down loose in a sea that covered a large area, of which Pennsylvania was only a small part. As the first layers were buried beneath later deposits they were compressed by the increasing weight and slowly hardened into rock. These rocks have ripple marks on their bedding faces such as are made by wind and waves in shallow water and on beaches; they have cracks like those made in a dried-up mud puddle; and other evidence that they were laid down in shallow water.

As the sediments accumulated to a total thickness of thousands of feet the sea bottom must have been slowly sinking while the sand and mud were being deposited on it. We see these rocks today because by slow movement of the earth's crust they have been raised above sea level. In some of them we now find the fossil shells of small animals that lived in the sea when the mud or sand that encases them was laid down.

In studying the sedimentary rocks of the earth's crust geologists have worked out a scheme for designating the position and relative age of the different beds. This is known as a geological time scale. In it the rocks are divided in such a way that each division or system represents a different stage in the development of life on the earth. If all time since life first appeared on the earth is divided into 15 periods, the rocks of Greene County belong in the 8th period or Upper Carboniferous. The relation of the Upper Carboniferous to the rest of the time scale is shown in this table, compiled by Geo. H. Ashley. State Geologist of Pennsylvania.

CARBONIFEROUS SYSTEM.

The surface rocks in Greene County belong to the Upper Carboniferous system. Four groups are present, the Conemaugh, Monongahela, Washington, and Greene. The upper part of the Conemaugh group is above water level on Monongahela River from just above Grays Landing to the West Virginia line and for a mile or so on Dunkard Creek. This group is exposed only in this very limited area. The Monongahela group is exposed all along Monongahela River from the West Virginia line to Washington County, on Dunkard Creek up to Mount Morris, on Whiteley Creek to Whiteley, Muddy Creek to Carmichaels, and on South Fork of Tenmile Creek up to Waynesburg. In the western part of the county only a few feet of the Monongahela group reaches the surface in exposure on Dunkard and Enlow Forks of Wheeling Creek below Crabapple and Burdette. The other two rock groups, which make the Dunkard series, cover about 90 per cent of the county. A generalized section of the rocks exposed in Greene County is given on the columnar section sheet.

CONEMAUGH GROUP.

Along the bank of Monongahela River south of Grays Landing the Pittsburgh coal rises gradually above river level and is 370 feet above the water opposite the mouth of Cheat River. The lower part of the section is concealed by hill wash.

Geologic Time Scale.

Eras	Ages	Periods	Systems	Average thickness in feet	Dominant life	Estimated length in years
Cenozoic		15th	Quaternary			1,000,000
	Tertiary	14th 13th	Upper Tertiary Lower Tertiary	5,000 5,000	Mammals	60,000,000
Mesozoic	Cretaceous	12th 11th	Upper Cretaceous Lower Cretaceous	5,000 4,000	Specialization and decline of reptiles	75,000,000
	Jura-Trias	10th 9th	Jurassic Triassic	3,000 5,000	Reptiles	40,000,000 40,000,000
Paleozoic	Carboniferous	8th 7th 6th	Permian Pennsylvanian Mississippian	3,500 4,500 2,000	Amphibians Coal-forming plants	115,000,000
	Siluro-Devonian	5th 4th	Devonian Silurian	5,000 3,000	Fishes	50,000,000 40,000,000
	Taconic	3rd 2nd 1st	Ordovician Canadian Cambrian	3,000 3,000 5,000	Invertebrates	{ 110,000,000 { 90,000,000

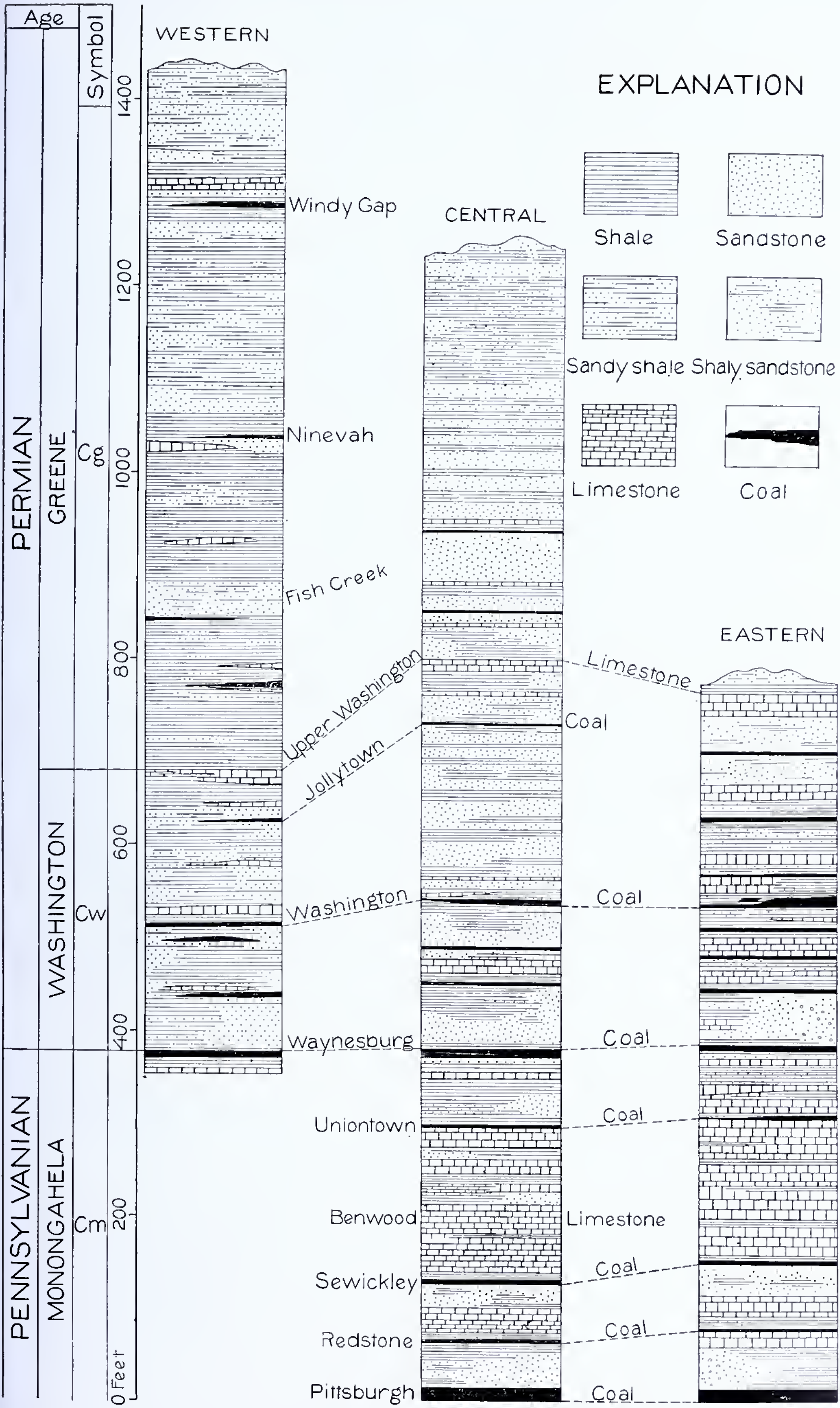

Fig. 14. Columnar sections of eastern, central, and western Greene County.

Below the Pittsburgh coal there is usually 50 to 80 feet of shale with thin beds of limestone. The shale is underlain by the Connellsville sandstone. This sandstone in some places is over 40 feet thick, in other places this interval is occupied by 15 to 20 feet of sandstone and the rest is shaly or thin flaggy sandstone. Under this sandstone is 15 to 30 feet of shale with a thin limestone and a small coal bed. Then comes the Morgantown sandstone or First Dunkard sand. It is about 80 feet thick, and may be underlain by a thin coal bed, below which is the concealed interval which is presumed to be largely shale.

MONONGAHELA GROUP.

General statement. The Monongahela group extends from the base of the Pittsburgh coal to the top of the Waynesburg coal, and was called in earlier reports the Upper Productive Measures. The group ranges in thickness in this county from 279 feet to 405 feet, according to the records of wells that passed through it. These extremes may be in error, owing to erroneous identification of strata by the driller. There is no doubt, however, that the thickness varies from place to place. An average for the county is about 330 feet. The following table based on well records collected many years ago pertains to this matter.

Thickness of Monongahela group in Greene County.

	Thickness, in feet			*Number of records*
Township	*Least*	*Greatest*	*Average*	*used*
Dunkard	366	409	378	10
Jefferson	299	322	307	2
Morgan	320	369	334	5
Whiteley	313	363	332	8
Franklin	314	392	337	19
Washington	314	340	328	5
Wayne	323	360	341	9
Morris	299	353	317	8
Center	304	380	320	11
Richhill	273	374	310	36
Gilmore	313	340	331	4
Jackson	...	359	359	1
Aleppo	279	362	313	8
Springhill	302	405	351	17
General average			333	

The Monongahela group differs from the Conemaugh group below and the Washington group above it in having much more coal and limestone. It contains over 100 feet of limestone, some heavy beds of sandstone, shales, and five persistent coal beds. The Pittsburgh coal, which is at the base of the group, is the thickest bed, is probably the least variable, and has the shortest outcrop line of all the workable coals in the county. The Sewickley (Mapletown) and Waynesburg coal beds are of workable thickness, but the Redstone and Uniontown coals are too thin to be of value.

Pittsburgh coal. The Pittsburgh coal underlies an area 50 miles long and 50 miles wide in the southwest corner of the State as shown by Figure 18. It underlies all of Greene and Washington Counties and extends east into Fayette County, and north into Allegheny and

Indiana counties. It is from 6 to 10 feet thick, more uniform in quality and thickness, and for a given area more valuable than any other bed in the bituminous field of Pennsylvania.

The Pittsburgh coal outcrops along Tenmile Creek between Monongahela River and Trumbull, less than two miles, but is so close to water level that the underlying rocks at the top of the Conemaugh group are below the surface or hidden by the flood plain. Although the Pittsburgh coal is mined at water level at the mouth of Tenmile Creek, it is deep below the river at Rices Landing, Crucible, and Nemacolin, and first rises above the level of the river at Grays Landing. From here south it rises higher until at Dilliner it is 220 feet above the river.

Drill records attest the presence of the Pittsburgh coal under all parts of Greene County with about the same thickness that it has in outcrop along the river. It lies at considerable depth below the surface, about 900 feet near Rutan and Aleppo, but it is only a question of time when it will be reached by shafts.

A sandstone about 50 feet thick overlies the Pittsburgh coal. It is in part rather thin bedded and shaly, and its place may in some localities be occupied by shale. Above it there is likely to be limestone, as at Alicia Mine No. 2 near Grays Landing, where 10 feet or more of rather solid limestone lies just under the Redstone coal. This is called the Redstone limestone.

Redstone coal. A coal too thin to be of value is found 40 to 70 feet above the Pittsburgh coal where the latter outcrops, and does not seem to be notable elsewhere in the county for it is rarely recorded in deep wells. Above the Redstone coal is shale, limestone, and sandstone filling the interval of 50 to 70 feet up to the next coal.

Sewickley (Mapletown) coal. The Sewickley coal, known in this locality as the Mapletown coal because it has been mined extensively for local use at Mapletown in the southeastern part of the county, is about 120 feet above the Pittsburgh coal. According to records of wells in Dunkard Township the interval between the Mapletown and Pittsburgh coals ranges between 91 and 145 feet.

In Greene County this coal outcrops along Tenmile Creek below Clarksville, where it is 12 to 22 inches thick and so of no present value. It is exposed also from Grays Landing to Dunkard Creek, and being much thicker is mined in several places.

Benwood limestone. Lithologically the most distinctive feature of the Monongahela group is the abundance of limestone. The greatest aggregation of limy beds is the Benwood or Great limestone which lies just above the Sewickley coal and is in places 150 feet thick. The name is derived from an excellent exposure at Benwood, 4 miles south of Wheeling, West Virginia, and the term is restricted to the strata between the Sewickley and Uniontown coals. This limestone is nowhere a solid bed, being divided by layers of shale and thin sandstone into two large divisions, and these in turn by bands of limy shale into layers. The lower division is about 60 feet thick and is composed of bands of limestone two to three feet thick alternating with thin partings of calcareous shale. The upper division of the Benwood limestone is 6 to 20 feet thick, and composed of beds a foot or more thick with interstratified thin layers of shale. The lower division is more persistent than the upper. Certain layers are pure enough for making lime, while others are worthless.

The Benwood limestone is well exposed on Tenmile Creek below Jefferson in railroad cuts and in the creek bank at Clarksville; at Rices Landing, and up the Monongahela in the sharp ravines that lead down to the river, and on Meadow Run below Davistown.

Uniontown coal. Directly on top of the Benwood limestone a small coal blossom can usually be found. It seems to be persistent as a thin coal seam or as bituminous shale, but rarely is more than a foot thick. This bed, known as the Uniontown from an occurrence of workable thickness at that place, is 60 to 80 feet below the Waynesburg coal.

Waynesburg limestone. The interval between the Uniontown and Waynesburg coals is occupied by sandstone and shale, with a 10-foot bed of limestone 25 feet below the Waynesburg coal. This bed, which is known as the Waynesburg limestone, is persistent and can often be found where a road or stream crosses its horizon. It is light colored and fairly heavy bedded, and can be recognized by its relation to the well-known coal so close above it. This limestone is exposed in Muddy Run one mile below Carmichaels, in Pumpkin Run at the amusement park, under the highway concrete bridge over the railroad 1½ miles west of Jefferson, in the lower end of Braden Run and at many other places in the eastern end of the county.

Above the Waynesburg limestone one usually finds shaly sandstone, and the Waynesburg coal usually rests on shale or fire clay.

Waynesburg coal. This coal bed, that takes its name from the county seat where it has long been mined, is the top bed of the Monongahela group. It varies in thickness from 5 to 9 feet, may carry many thin shale partings or one or two thick ones and frequently contains much iron pyrite. It is a persistent bed and underlies practically all of the county, for its outcrop is confined to the valleys of the larger streams in the eastern part of the county, and to the forks of Wheeling Creek on the western county line. As shown on the geologic map the outcrop extends up the South Fork of Tenmile Creek to within a mile of Waynesburg, up Muddy Run to Carmichaels, up Whiteley Creek to Whiteley village, along Dunkard Creek and Meadow Run to Davistown and up Wheeling Creek to Durbin and Burdette. It is mined at many small country banks for local use.

Fossils. The flora of the Monongahela group appears to be characterized by a great abundance of representatives of the types of *Neuropteris scheuchzeri*, and *Neuropteris ovata;* by pecopterids of the large-pinnuled group, and by odontopterids of the type of *Odontopteris brardii.* In this group the lepidophytes are waning, the genus *Lepidodendron* having nearly disappeared, and the genus *Sigillaria* being represented by the *S. brardii* group. The limestones which fill so much of the interval between the Pittsburgh and Waynesburg coals and which may indicate deep-water conditions, show no marine fossils. The only molluscan forms they contain are a few bivalve crustaceans. The fauna of the whole group seems to be restricted to fresh-water types.

DUNKARD SERIES.

General statement. The rocks extending from the roof shales of the Waynesburg coal to the topmost beds of the Carboniferous in the Appalachian region are designated as the Dunkard series. The name is derived from Dunkard Creek, along which the rocks outcrop between

Mount Morris and Nettle Hill. It is not known how great the original thickness of this series of rocks may have been but the greatest thickness remaining is about 1,100 feet. The highest beds in the series are in the tops of the hills in western Aleppo and Springhill townships, which is not far from the deepest portion of the Appalachian coal basin As the rocks remaining are mostly soft shales and sandstones that are easily eroded, it may be surmised that several hundred feet of higher and younger strata constituting the last of Permian sedimentation in this region, have been removed by erosion.

In general the Dunkard series consists of shale and shaly sandstone and a number of thin limestones. In the lower 200 feet of the series there are several thin coal beds. In Greene County the Dunkard carries many beds of red shale, which disappear however toward Washington County, giving place to the ordinary drab or tan shales. An occasional heavy sandstone makes a ledge but for the most part the rocks are so soft that they weather to considerable depth and outcrops are few. It is difficult to trace any of the higher beds for this reason.

The Dunkard series is divided into two groups, the Washington group extending from the top of the Waynesburg coal to the top of the Upper Washington limestone, and the Greene group includes all Permian rocks in this area above the Upper Washington limestone. The division between groups was placed at the top of the Upper Washington limestone because that stratum is the most persistent and easily recognized member of the series. Its horizon is 250 to 400 feet above the Waynesburg coal.

WASHINGTON GROUP.

This group underlies much of the surface of the county east of Waynesburg. The ridges are capped by the Greene group but all of the valleys from the river west to Castile, Waynesburg, Smith Creek, and Shannon Run are broad expanses of Washington strata. In the western half of the county the principal areas of this group are in Richhill Township.

The Washington group is composed of shales, sandstones, and thin beds of limestone and coal. The principal or more conspicuous members are described below. The intervals between them are occupied largely by shales and thin bedded sandstone, details of which are meager because outcrops are few on account of the softness of the rocks.

Cassville shale. The base of the Washington group is shale up to 12 feet thick, which forms the roof of the Waynesburg coal. Where this shale is absent, the Waynesburg sandstone rests directly on the coal. This shale is notable because it always bears fossil plants. The type locality is Cassville, West Virginia, but beautiful impressions of fossil leaves can be found in this shale one foot or more above the Waynesburg coal where it is well exposed for half a mile along Muddy Creek at Carmichaels, near Parkers Landing, and on Dunkard Creek below Mount Morris.

Waynesburg sandstone. This sandstone is a massive bed 40 to 70 feet thick, separated in places into two nearly equal parts by sandy shale. It is coarse grained, light-gray to yellowish-gray or buff. Strong cross-bedding is not uncommon, and flaggy layers occur as well as massive. There are a few places, as on Hunters Fork, where the sandstone is absent and its place is occupied by shale.

The Waynesburg sandstone is well exposed at many places on Tenmile Creek from Laurel Run to Jefferson, in the ravine below the cemetery at Carmichaels, just above the coal at Davistown, Whiteley, and Mount Morris, and on Dunkard Fork and Crabapple Creek near Durbin.

Waynesburg A coal. Separated from the Waynesburg sandstone by a few feet of sandy shale, and 65 to 90 feet above the Waynesburg coal, occurs a persistent coal bed known as the Waynesburg A. In some places it is more than two feet thick but commonly is only one foot or a mere bloom. Nowhere is it worth mining today. About 30 feet above it is the Waynesburg B, or Little Washington coal, which is rarely more than a few inches thick, but nevertheless is rather persistently found where the horizon is exposed.

Washington coal. The only coal bed in the Washington group that has been mined is the Washington coal, which lies 115 to 180 feet above the Waynesburg coal and directly below the Lower Washington limestone. Near Ryerson Station the bed is 4 feet 3 inches thick, of which only 2 feet 7 inches is coal. The coal in this bed is in four benches, the thickest of which is 23 inches. Except near Ryerson Station and on Crabapple Creek where ths coal has been opened in a number of places, it is thin throughout the county. The blossom is persistent however.

Lower Washington limestone. Either resting directly on the Washington coal or separated from it by a few feet of shale is the lowest of three more or less persistent limestones in the Washington group. It ranges in thickness from a mere trace to 5 feet, and in color from light slate-gray to blue-gray, mottled, or brecciated.

Section of Lower Washington limestone 1 mile WNW of Ryerson Station.

	Ft.	In.
Limestone	1	8
Shale	1	1
Limestone	1	6
	4	3

Above this limestone is an interval of about 180 feet of thin sandstone and shale capped by the Jollytown coal. Near the bottom of this interval at some places in the western part of the county there occurs a 3-foot limestone with a yellowish weathered surface, that is supposed to be the Middle Washington limestone.

Jollytown coal. Following the usage of J. J. Stevenson a thin but persistent coal bed about 50 feet below the Upper Washington limestone is called the Jollytown coal. Its distance above the Waynesburg coal is 400 feet near Dunkard Creek and 300 feet in Washington Township. Along Dunkard Creek it is about 20 inches thick and of fair quality; in most other places where seen it carries 6 to 12 inches of coal and is overlain by nodules of iron carbonate. A number of good outcrops of this coal can be seen on Tenmile Creek above Waynesburg, on Browns Creek, and on Overflowing Run.

Jollytown limestone. Somewhere between the Jollytown coal and Upper Washington limestone is an exceedingly persistent limestone.

It may be anywhere from 20 to 40 feet below the Upper Washington limestone and as much as 30 feet above the coal. It is hard and coarsely brecciated, weathering to dull gray, often tinged with yellow, and the weathered surface often has a roughened appearance. It is not more than 5 feet thick but it is so resistant to weathering that outcrops are numerous and its surface characteristics make it an important guide in stratigraphy. Blocks of this yellow limestone are widely distributed at the proper horizon.

Upper Washington limestone. The Upper Washington limestone is by far the most conspicuous and persistent member of the Dunkard series and for that reason and because of its intermediate position was chosen as the horizon upon which to divide the series into groups. Its position is 250 to 440 feet above the Waynesburg coal and 620 to nearly 800 feet above the Pittsburgh coal. The interval to the Pittsburgh coal changes from nearly 800 feet at Davistown to 650 feet at Ruff Creek. This is due to a thinning of 50 feet in the Monongahela group and of 100 feet or more in the Washington group.

This limestone is widely distributed in Greene County. Where no outcrop of it could be found in Whiteley, Perry, Dunkard, and southwest Richhill townships, it may be thin, absent, or masked by the debris from overlying soft rocks, but elsewhere, whether high in the ridges in Jefferson or low in the valleys of Washington and Center townships, it is conspicuously present to one who is looking for it.

The characteristics of the Upper Washington limestone are so marked in this region that it is easily recognized. Its outcrop is marked by irregularly rounded blocks. Everywhere it weathers to a gray-white. This color is in such strong contrast to that of other limestones in this region that it forms a means of certain identification. In case of any doubt the presence of the yellow Jollytown limestone 20 to 40 feet below is conclusive. The Upper Washington limestone is 4 to 15 feet thick and may be a single layer where thin or where thick divided into several benches by shaly limestone or shale. It is overlain by black shale containing many fossil leaves and shells. The limestone is brittle and rings when struck sharply with a hammer. On fresh fracture the rock is blue, almost black, drab, or mottled. In some exposures a close examination of the weathered surface reveals abundant black specks which a magnifying glass shows to be a bivalve crustacean, *Ostracoda,* a minute, jointed, crab-like animal protected by two shells. The writer observed this particularly at the quarry above Swarts. This is a fine exposure (see the chapter on Limestone for details) visible from the main highway. Other typical exposures are the road forks on Wisecarver Run 2 miles from West Waynesburg and on Purman Run 2 miles north of Waynesburg. There are numerous outcrops of this bed along the road up Boyd, Hopkins, and Overflowing Runs, Bates Fork, Browns Creek, Tenmile, Hargus, and Pursley creeks, and McCourtney Run. It has been quarried 2 miles west of Clarksville 60 feet below the summit of a hill 1,420 feet high. In Wayne Township white blocks of this limestone outcrop along Roberts Run nearly to its head. An excellent exposure in the road ascending the ridge on the east a mile south of Spraggs shows the usual characteristics.

GREENE GROUP.

General statement. West of a line up Shannon Run, down Smith Creek, and from Waynesburg to Castile the surface of the county is underlain by rocks of the Greene group, except for narrow bands in the valley bottoms where the top strata of the Washington group are exposed. In the eastern part of the county the Greene group occurs mostly in the crests of the ridges. This group consists of all solid rocks above the Upper Washington limestone and has a maximum thickness of 700 to 800 feet. The very highest beds or the youngest of the Dunkard rocks in Pennsylvania probably are the beds 100 feet above the Windy Gap limestone and over 1,400 feet above the Pittsburgh coal, in a 1,560 foot knob half a mile northwest of Morford in Aleppo Township.

The Greene group is composed of such soft rocks that good exposures of more than a few feet of strata are rare. Furthermore some of the members that are conspicuous in one township may be wholly lacking in another; they seem not to be persistent. In the eastern half of the county the beds are so variable and so poorly exposed that the sequence of strata can scarcely more than be guessed at. In most places it consists of shales and shaly sandstones. A few of the sandstones are massive but not persistently so. Thin beds of red shale, several thin limestones and coal beds are interspersed throughout the group. Some of the more conspicuous members of the group are mentioned below.

Bituminous shale. Directly above the Upper Washington limestone is a dark shale, more or less bituminous. This shale marks the base of the Greene group. In many places the shale is sufficiently bituminous to show a fracture like that of cannel coal. Then it contains abundant, well-preserved bivalve crustaceans and fish scales. In Washington County there is frequently a little coal a few feet above the limestone, and the shales are without much carbonaceous matter. When such is the case the shales are rich in impressions of leaves and stems. The next 50 to 100 feet of rocks is mostly shale, with here and there a thin sandstone.

Tenmile coal. In Richhill and Morris townships a coal bed everywhere less than 3 feet thick and valueless is found 50 to 100 feet above the Upper Washington limestone. This bed has been called the Jollytown in some reports but that name was first applied and so belongs to a coal below the Upper Washington limestone.

Dunkard coal. On top of another shaly series and perhaps 50 to 100 feet above the Tenmile coal is another coal bed that is only a foot or two in thickness. It generally is in two benches and is not persistent.

Fish Creek sandstone. In the hills of Morris, Center, Jackson, and Springhill townships a massive sandstone is found just above the Dunkard coal or about 200 feet above the Upper Washington limestone. It is the most prominent sandstone above the Waynesburg and takes its name from Fish Creek where, between New Freeport and Deep Valley, it makes a vertical cliff 50 feet high. The greatest thickness of this sandstone is about 60 feet but in some places only 10 or 15 feet of it may be massive bedded, the rest being flaggy. The stone is light grayish to greenish on fresh fracture and weathers to a greenish tan that is not pleasing. It is medium grained, arkosic, and the massive stone works well into dimension block. The abutments of the bridge at Rogersville and several houses in that vicinity and elsewhere in the western half of the county are built of the Fish Creek sandstone.

Nineveh coal. A coal bed rarely over a foot thick has been found at

Nineveh and at several other widely scattered points in the western part of the county. It is 130 to 150 feet above the Fish Creek sandstone. In this interval one or two horizons may carry limestone. One such on North Fork of Dunkard Fork is 5 to 10 feet thick but contains much interstratified shale and weathers somewhat like shale. In the southwest corner of the county there is a massive sandstone about 50 feet above the Nineveh coal. Above it is a considerable thickness of shale and shaly sandstone.

Gilmore sandstone. On the higher hills in the southwest part of the county, particularly in Gilmore, Jackson, Aleppo, and Springhill townships, a coarse massive sandstone bed ranging up to 30 feet thick, occurs 200 to 250 feet above the Nineveh coal. In some places it makes cavernous cliffs; elsewhere its position is marked by great bowlders or by a prominent bench. It is named from Gilmore Township.

Windy Gap coal. A few feet above the Gilmore sandstone is the horizon of the highest coal bed in the Appalachian coal basin. It is only coaly shale or at best very impure coal, and only a few inches thick, just enough to make a faint coal blossom. It has been observed in the roads near the top of the hills in southern Aleppo and northern Springhill townships and not far below a limestone.

Windy Gap limestone. Because it is only about 100 feet below the highest strata remaining in the Dunkard series, the Windy Gap limestone is restricted to the hilltops in a limited area like that of the Gilmore sandstone. This limestone, named from a locality 1.3 miles east of Morford, is a few feet above the horizon of the Windy Gap coal, and 40 to 60 feet above the Gilmore sandstone. It is dark bluish to bluish-black in color, and weathers light gray. The bed is composed of several layers which aggregate 8 to 10 feet in thickness. It contains minute fossil shells.

Fossils in the Dunkard series. The organic remains of the Dunkard series comprise fossil plants in large numbers and ostracods with occasional occurrences of pelecypoda and fish fragments. The flora is characterized by the continuance of the ubiquitous neuropterids noted in the Monongahela group; by the presence of a highly varied pecopterid element; also by the occurrence of several large obliquely-lobed sphenopterids, and by great quantities of small leafed *Sphenophylla.*

A black carbonaceous shale between the Lower Washington and Washington coals contains bivalve crustaceans and fish scales. This shale is exposed on Purman Run above the covered bridge in the village of Waynesburg.

Parts of the Upper Washington limestone contain bivalve crustaceans, and the bituminous shale above the limestone contains bivalve crustaceans and fish scales in abundance.

QUATERNARY SYSTEM.

PLEISTOCENE DEPOSITS.

Carmichaels formation. The deposition of sand and mud in the Appalachian inland waters was terminated by a movement of the earth's crust that raised this region above sea level and so ended the Dunkard epoch and Carboniferous age. It has been a land area ever since that time, subject to general erosion. Great quantities of rock waste have been removed in the wearing down of the surface and carried away as silt to be deposited on the flood plains of the Ohio and Mississippi or on the delta at its mouth. No deposition has taken place in this county except in the latest period of geologic history, when local deposits were laid down in the channel occupied by Monongahela River in Pleistocene time, and in the present stream channels in recent time.

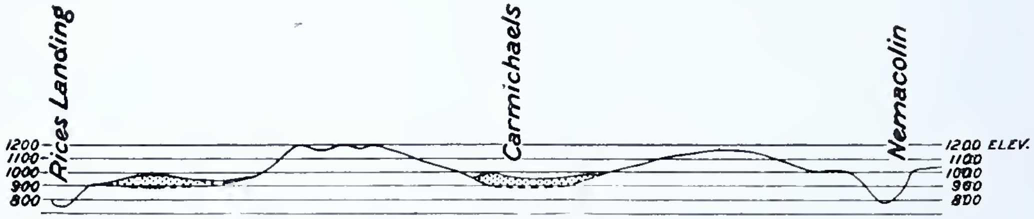

Fig. 15. Cross section from Rices Landing to Nemacolin showing relation of Pleistocene gravels to present topography.

The Pleistocene deposits are accumulations of sand, clay, and gravel above the flood plains of the present creeks, and in the abandoned channels of Monongahela River. They are called the Carmichaels formation from the village in eastern Greene County. As described in the chapter on Topography this village is in an old channel of the river which is filled to a depth of 60 feet or more with unconsolidated deposits. As the valley was originally occupied by an active stream the lowest materials are coarse and well rounded. Above this coarse gravel the succession of material varied from time to time with no apparent regularity. The water appears to have been still at times and exceedingly fine clay was laid down in thin layers; at other times fairly strong currents prevailed and brought in sand and coarser material. It is conjectured that these deposits were formed when the great ice sheet or continental glacier moved down from the north, covered northwestern Pennsylvania, filled up the valley of Allegheny River, and so converted the lower course of Monongahela River into a long, narrow lake. The evidence suggests that this took place during the first great ice invasion in the east, and this probably corresponds with the Kansan stage of glaciation of the Mississippi Valley.

The ponded waters in the Monogahela naturally backed up the tributary streams and when the channel at Carmichaels was being filled, deposition was taking place similarly in the lesser streams. Remnants of the Carmichael formation therefore are found for some distance up the tributary streams. If one traverses Muddy Creek or Whiteley Creek from its head toward its mouth, the wide valley bottom appears to be but a normal development of flood plain. If one comes from the east, however, this valley bottom seems to have a different origin. The deposit in the valley of Muddy Creek is continuous with that which fills the abandoned channel at Carmichaels. The top soil, of course, is true alluvium, but the larger deposit, which gives the narrow valley a broad floor, is Carmichael clay.

Whiteley Creek has cut out the Carmichael clay as far as the village of Whiteley. Unquestionably the clay originally filled the lower valley for Mapletown is built on a remnant of the old filling. Carmichael clay makes the flat bottom from Woods to Lanz Run and above. Dunkard Creek has cut below its Pleistocene filling, except for patches left on terraces 20 to 60 feet above the present stream.

On South Fork of Tenmile Creek the Carmichael formation has been recognized on a rock floor that rises from about 950 feet at Jefferson to 1000 feet at Rogersville. Its position at Waynesburg is between the railroad and the South Side high school. There is a large area of this formation south and west of Jefferson and the road from Jefferson to Rices Landing crosses a plain which is covered with this silt. Here may have been the former outlet of South Fork of Tenmile Creek to the Monongahela. On this plain are places where small quartz pebbles are numerous, and the writer once found a number of rounded bowlders of hard sandstone, 8 to 12 inches in diameter. These bowlders are too large to have been rolled here by the currents which carried the fine material on which they lie. The easiest explanation is that they were floated in on blocks of ice when the stream was flowing at the high level it is known to have had in early glacial time.

Deposits of the Carmichael formation are not confined to Monongahela drainage. Similar deposits were formed on the Youghiogheny, Conemaugh, Allegheny, and Beaver rivers, and many branches of Ohio River. On Dunkard Fork of Wheeling Creek near Durbin a few thin deposits of gravel have been found up to an elevation of about 980 feet on rock benches 25 to 40 feet above the present stream. A thin layer of silt overlies the coarser part of the deposit. These bench deposits are believed to be of the same age as the Carmichael formation in the eastern part of the county.

RECENT DEPOSITS.

Alluvium. The deposits of sand and silt accumulated on the flood plains of the present streams by annual floods are known as alluvium. The size of alluvial deposits usually increases with the size of the stream and progressively down stream. Monongahela River has comparatively little flood plain. This is explained by the fact that elevation of the surface since Pleistocene time has produced a new cycle of erosion and the river is actively engaged in deepening its channel. This uplift presumably took place at the close of the Kansan stage of the Glacial epoch and must have been greater than the depth of the present channel below the floor of the abandoned channel. This difference is about 150 feet and the uplift may well have been 200 feet or more. Until the Monongahela reaches such a grade that it stops active deepening of the channel and begins widening the valley there can be no extensive development of flood plain.

This uplift has affected the lower courses of the tributaries, but in some places the upper courses seem to retain in their flood plains traces of the broad valleys developed in the erosion cycle preceding the last uplift.

The valleys of most of the streams in Greene County are so narrow that the flood plains are scarcely more than 100 yards wide and are too small to show on the map.

Good examples of alluvium or flood plain deposits are the flat areas along South Fork of Tenmile Creek at Clarksville, along Ruff Creek, and between Waynesburg and the mouth of Browns Creek.

GEOLOGIC STRUCTURE.

INTRODUCTION.

Geologic structure is the position or lay of the rock beds below the surface. If we could uncover the Pittsburgh coal in all southwestern

Pennsylvania so that it alone made the surface we would find ourselves in a gently rolling country, in general shaped like a basin or trough, with more or less parallel low ridges. This chapter describes these low ridges, rolls, or waves in the rock beds, the features that constitute geologic structure.

The structure shown on Plate II is largely from an earlier report on Greene County.[1] Alterations have been made along the western and southern boundary to harmonize with the structure as mapped subsequently by the West Virginia Geological Survey, and in Greene, Whiteley, and Perry townships on the basis of a more detailed structural map made by the geologic department of the Peoples Natural Gas Company, Pittsburgh, from the logs of many wells drilled in that area since the writer's original mapping in 1901.

Greene County is near the center of the great bituminous coal basin. The structural features have the general northeast-southwest trend which is characteristic of most of the Appalachian province, while the crests of the anticlines and the troughs of the synclines crossing this county are successively low from east to west. These folds in the rocks are shown by the structure contour lines (or lines of equal elevation) on the accompanying map (Plate II). The floor of the Pittsburgh coal is the reference surface, and at all points along a given contour line the Pittsburgh coal has the same elevation above sea level; and on the adjacent contour the coal is 50 feet higher or lower, as the case may be. Thus the contour lines represent the shape of the folds. The Pittsburgh coal is seen at the surface in Greene County only at the mouth of Tenmile Creek and on the Monongahela River above Grays Landing. In other parts of the county its position has been calculated from higher beds, which show at the surface and also from the records of a large number of deep wells. Enough such data have been obtained to make the determination of the position of the coal accurate within a contour interval, although the bed is several hundred feet below the surface throughout much of the area. The geologic structure is described from east to west across the county.

FAYETTE ANTICLINE.

This arch in the rocks is strongly developed across Fayette and Westmoreland counties. The axis crosses Redstone Creek above Waltersburg and approaches Monongahela River near the State line, entering Greene County, if at all, in the extreme southeast corner. Although the axis may not cross this county, the western flank of the anticline is shown in the dip of the rocks from Dilliner to Mount Morris. The evidence for determining the structure in this corner of the county is the outcrop of the Pittsburgh coal along Dunkard Creek and its depth in wells drilled between Mount Morris and Davistown. The crest of the fold as it crosses Fayette County decreases in elevation toward the south, and at the Greene County line the Pittsburgh coal is about 1,150 feet above tide. From the river to Mount Morris the dip of the beds down the flank is fairly regular and carries the coal down to 500 feet above tide.

LAMBERT SYNCLINE.

A basin next on the west of the Fayette anticline has an irregular outline, and its axis pursues an indirect course, crossing Monongahela River at Nemacolin and entering Greene County with a westerly trend.

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[1] Stone, R. W., and Clapp, F. G., Oil and gas fields of Greene County, Pa.: U. S. Geol. Survey Bull. 304, 110 pp., 1907.

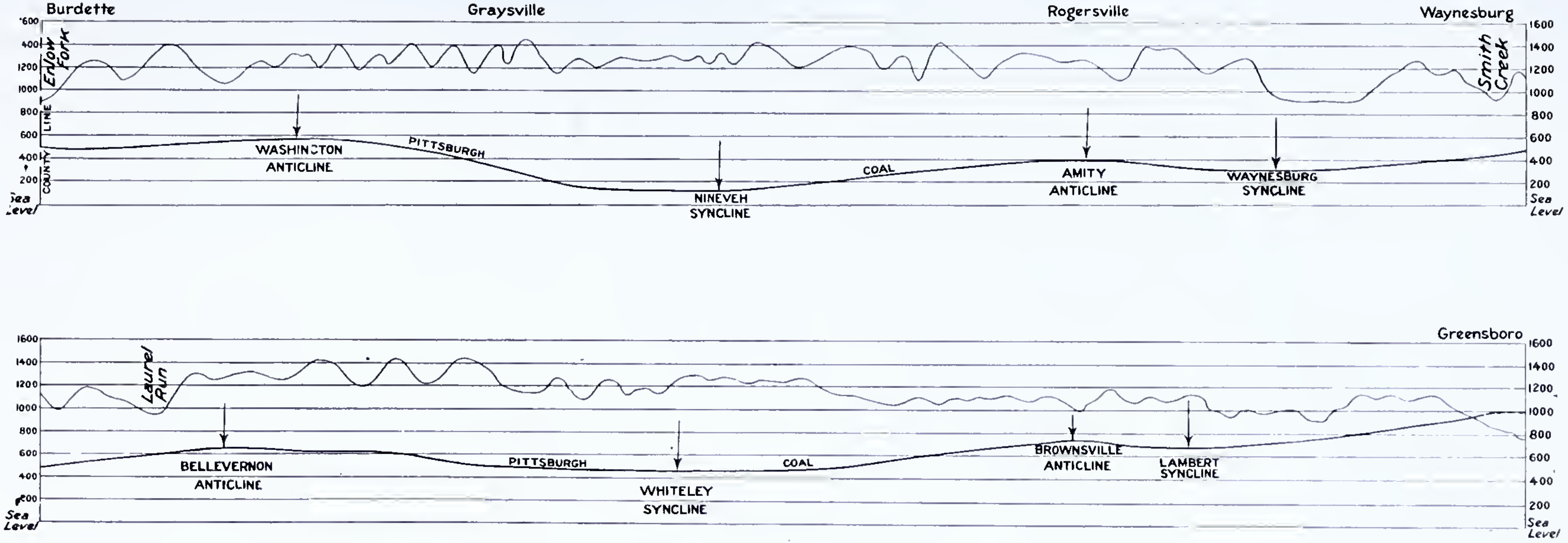

Fig. 16. Cross section of geologic structure from Greensboro via Waynesburg to Burdette showing folds in rock structure as determined by the position of the Pittsburgh coal, and its relation to the surface.

A mile west of the river it turns southward, passing through Paisley and terminating somewhat indefinitely near Willow Tree. The axis rises to the south, so that the Pittsburgh coal, which is 550 feet above sea level at the river, is 150 feet higher at the south end of the basin.

In Perry Township nearly a mile west of Mount Morris is a minor syncline which makes the first reversal of dip on the western flank of the Fayette anticline along the State line. The Pittsburgh coal descends to 410 feet above sea level where the synclinal axis crosses the State line and then rises gently westward to the Mooresville anticline. This structure has been called the Lambert syncline by the West Virginia Geological Survey, a correlation which will prove to be correct if future drilling between Whiteley and Davistown shows a sag in the structure not indicated by present information.

MOORESVILLE ANTICLINE.

A low fold, the crest of which passes close to Mooresville, W. Va., carries the Pittsburgh coal up to a little more than 460 feet about 2.5 miles west of Mount Morris. This fold forks to the north and dies out within Perry Township.

BROWNSVILLE ANTICLINE.

The rocks rise westward from the Lambert syncline in an irregular arch which is called the Brownsville anticline. The axis of this fold passes just east of the town of Brownsville, crosses Monongahela River at the mouth of Muddy Run, and pursues a southerly course parallel to Muddy Run and Glade Run and thence to Turkey Knob. In Greene County this anticline is but a slight undulation and poorly defined, but it has the effect of throwing the strike of the flank of the Fayette anticline in the vicinity of Davistown into a north-south direction. The Brownsville anticline is a minor wrinkle in a large synclinal basin, the eastern limb of which rises to the Fayette anticline and the western limb to the Bellevernon anticline, which lies farther west. The determination of structure here is from the outcrop of the Waynesburg coal.

WHITELEY SYNCLINE.

The Whiteley syncline lies between the Fayette and Bellevernon anticlines, as does the Port Royal syncline farther north. The Port Royal syncline, however, loses its basin-like character in the vicinity of Fayette City, on Monongahela River, and the axis does not seem to be continuous with the axis here described.

Conditions are such that the accurate determination of the structure of the northern end this basin is not easy. The rocks showing at the surface are of such a character that tracing and definite correlation are impracticable, and few deep wells have been drilled near Khedive which give any light on the depth of the Pittsburgh coal below the surface. Therefore the location of the structure contours in this part of the area is regarded as less accurate than in some other areas.

The Whiteley syncline is broad and shallow, deepening toward the south. The axis of the trough passes near Fordyce and Kirby and crosses Dunkard Creek just south of the State line, about 1.5 mile east of Blacksville, W. Va.

BELLEVERNON ANTICLINE.

The Bellevernon anticline is the most pronounced and important structural feature in Greene County. Its axis crosses Tenmile Creek and the county line a mile northeast of Clarksville and holds a direct southwest course for 14 miles to the head of Smith Creek, where it turns to the south between Roberts and Rudolph runs and gradually flattens out. The axis crosses the State line at Blacksville and disappears soon after entering West Virginia.

The Pittsburgh coal, which is the reference stratum on which the structure contour lines are drawn, is at an elevation of 1,000 feet at the point where the Bellevernon anticline crosses Monongahela River between Bellevernon and Charleroi; it is 750 feet above tide at Clarksville and only 390 feet above tide at Blacksville. It should be noted that conditions are favorable for the accurate determination of the position of the reference stratum along the Bellevernon anticline in Greene County. The Waynesburg coal outcrops on Tenmile Creek from Monongahela River to Waynesburg, and the interval between it and the Pittsburgh coal is known. Moreover, the depth of the Pittsburgh coal below the surface is shown in many deep wells located along the anticline, and when the elevation of the well mouths is known the elevation of the reference stratum above mean sea level is easily determined. It is believed that the true position of the Pittsburgh coal at any point on the west flank of the anticline down to the 400-foot contour line varies scarcely more than 10 feet from the position indicated on the map.

The eastern slope of the Bellevernon anticline is short and gentle in the region of the greatest development of the Waynesburg gas field. From the crest of the fold near the mouth of Braden Run on Tenmile Creek to the bottom of the Whiteley syncline on Muddy Creek is a fall of scarcely more than 200 feet. From the same point to the axis of the Waynesburg syncline on the west the Pittsburgh coal descends fully 400 feet. The regularity of the western flank of the Bellevernon anticline is shown by the contour lines on the map. The course of the axis from the head of Smith Creek to Blacksville is irregular.

WAYNESBURG SYNCLINE.

The axis of the Waynesburg syncline crosses the Washington-Greene County line about a mile west of Castile, Ruff Creek near the mouth of Boyd Run, and Browns Creek at Rees Mill, 2 miles west of Waynesburg. Continuing in a southwesterly direction it intersects South Fork of Tenmile Creek one-half mile above Pursley Creek, then swings southward, strikes Wayne Township near the head of Pursley Creek, turns slightly southwestward, and passes just west of the village of Hoovers Run. It crosses Pennsylvania Fork of Dunkard Creek 1 mile east of Jollytown.

The structure of this basin is determined by the records of several deep wells which show the position of the Pittsburgh coal, and in the northern part of the county by the elevation at the surface of the Upper Washington limestone. It is possible that the basin may be somewhat deeper in the vicinity of Waynesburg than represented on the map. A well on the Wisecarver farm, on Wisecarver Run, found the Pittsburgh coal about 285 feet above sea level, but the evidence was not sufficient to warrant drawing the 300-foot contour line on the coal. Near the head of Pursley Creek the coal lies about 350 feet above tide, and on the southern boundary of the State its elevation is about 300 feet.

AMITY ANTICLINE.

From the trough of the Waynesburg syncline the rocks rise to the west more gradually than to the east, and a low anticlinal fold enters the county in the northwest corner of Washington Township. This fold has been traced northward into Washington County beyond the village of Amity and is named from that place. Where the fold enters Greene County from the north its crest is probably not more than 100 feet above the axis of the Waynesburg syncline, but it rises rapidly in Washington County and becomes a more pronounced structural feature.

According to deep-well records the Pittsburgh coal is about 475 feet above sea level on the crest of the Amity anticline at the point where it crosses the northern border of the county. One mile east of Hackneys, Washington County, where the axis crosses Tenmile Creek, its elevation is 495 feet. At Amity it is about 550 feet and at Lone Pine about 650 feet. In the vicinity of Swarts the Amity anticline turns directly southward, but at Browns Creek it veers slightly to the southwest and passes almost directly through the town of Rogersville, near which it seems to die out. At Rogersville the coal is probably less than 350 feet above sea level. West of the Amity anticline the rocks dip with a medium grade to the bottom of the Nineveh syncline.

By reference to the structure map (Plate II) a dome-like arrangement of the contours is seen nearly in line with a continuation of the Amity anticline in the vicinity of Buzz, Bluff and White Cottage, suggesting a continuation of the anticline in this part of the county. The Pittsburgh coal is about 400 feet above sea level just east of White Cottage and about the same altitude 1 to 2 miles southeast of Bluff. Over a considerable area between White Cottage and Pursley Creek the structure is rather flat. South of this area there is a faint continuation of the anticlinal arch to the State line, but the rocks are descending, the coal being 342 feet above sea in a well on Blockhouse Run and 331 feet on Garrison Fork of Dunkard Creek. The arch is here barely 50 feet above the bottom of the adjacent syncline on the east, and so gentle that the location of the axis is difficult to determine. It may cross the State line about 1½ miles southwest of Jollytown.

Minor folds. Crossing the south line of Springhill Township are four minor folds. From east to west they are the Robinson syncline, Hundred anticline, Burchfield syncline, and Littleton anticline. The difference in elevation between crest of arch and bottom of trough is less than 100 feet in each case. These low folds fade out to the north and their position on Fish Creek can be determined, if at all, only by precise surveying.

All of these structures have been traced for several miles in West Virginia and were named by Ray V. Hennen[1] of the West Virginia Geological Survey, from towns and stations in that State through or near which the axes pass.

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[1] Hennen, R. V., Marshall, Tyler and Wetzel counties: West Va. Geol. Survey report, 1909.

NINEVEH SYNCLINE.

This is one of the most pronounced troughs in Greene County. It was recognized and named by Stevenson in 1876. It enters the county in Morris Township and takes a course averaging S. 40° W., but varies 25° from this course. It passes just west of Nineveh, 1 mile west of Rutan, ½ mile southeast of Bristoria, 1 mile northwest of Higbee, and nearly through Aleppo and Morford.

The Nineveh syncline is located about the center of the Appalachian basin, of which it is one of the deepest troughs. At two points, near Rutan and in the vicinity of Morford, the Pittsburgh coal at the center of the basin is only about 100 feet above sea level. The Morford depression is very small and rather hypothetical, but the Rutan basin contains one well in which the coal was found as low as 95 feet above sea level. The location of the axis of the Nineveh syncline is better determined than any of the other axes in this part of the county, as numerous wells have been drilled on both sides of it for a great part of its course. Between Aleppo and Lick Run especially it is clearly defined by the wells of the Bristoria and the north end of the New Freeport oil fields. The mapping at Nineveh is likewise very close. At the northern edge of the county, between Rutan and Nineveh, and southwestward from Aleppo, however, it has been necessary to interpolate the coal contours entirely on the basis of surface rocks. With the exception of the two deep basins mentioned above, the coal in the bottom of the Nineveh syncline lies in general between 100 and 200 feet in elevation. North of Nineveh it is rising and on the edge of the county attains an altitude of about 300 feet.

East of the Nineveh axis the structure is rather diverse. In the vicinity of Nineveh there is a fairly uniform rise to the crest of the Amity anticline, but south of this place the anticline dies out and the dips grow more gentle. From indications gathered along the eastern border of the New Freeport gas field and from the records of wells in southern Gilmore Township there seems to be a slight depression here, the north end of the Robinson syncline which has been mapped to the south. Between New Freeport and Triumph, in the depression mentioned, the Pittsburgh coal is less than 240 feet above sea level. The Littleton anticline separating this minor basin from the Nineveh syncline is well marked, passing directly through New Freeport and thence continuing in a southwesterly direction. Between the Robinson syncline and Littleton anticline are the Burchfield syncline and Hundred anticline, the northern end of which seems to fade out at the head of Bissett Run. On the east side of the Nineveh axis from Bristoria southward to Fish Creek the positions of the 200- and 250-foot contours on the Pittsburgh coal are in places well determined, owing to the great oil development in this locality. Northwest of Deep Valley and northwest of Morford the dips of the surface sandstones and limestones seem to indicate two small domes in the structure.

West of the Nineveh syncline throughout its entire length the rocks rise rapidly to the crest of the Washington anticline. The greatest rise is between Rutan and Jacksonville, and amounts to 600 feet.

WASHINGTON ANTICLINE.

This fold is a prominent structural feature. Stevenson named it in 1876 from the town of Washington, near which it passes and from which it extends southwestward, entering Greene County in Richhill Township near Simpson Store. Thence it sweeps to the west in a fairly regular curve, passing through Jacksonville and just southeast of Ryerson Station, and thence into West Virginia with a course S. 60°-70° W. The elevation of the Pittsburgh coal on the axis of this arch varies from 480 to 705 feet above tide.

The most prominent feature of the fold in this county is a roughly triangular dome, having its center at Jacksonville. North of this dome the axis plunges to the vicinity of Simpson Store, where the elevation of the coal is about 480 feet, but beyond this place it rises again.

The grade along the southeastern flank of the Washington anticline in general averages 100 feet per mile, but between Graysville and Bristoria it amounts to 250 feet per mile. In this region and as far north as Enlow Fork of Wheeling Creek the contours are rather accurately placed, being determined by logs of wells in the Richhill gas field.

The dips on the western flank of the Washington anticline are much more gentle. Information about the structure of this part of the county has been derived from outcrops of the Waynesburg and Washington coals on Crabapple Creek and Enlow Fork and from a few limestone and sandstone beds. There are a few scattering wells in this vicinity. The dip of the rocks rarely exceeds 100 feet per mile and in some places is less than 50 feet. West of Jacksonville a spur of the anticline shoots off to the northwest, reaching as far as the western edge of the county.

HISTORICAL GEOLOGY.

PALEOZOIC ERA.

Greene County is near the center of the great Appalachian synclinal basin and the pre-Devonian rocks are buried far beneath the surface. The sequence of events during Cambrian, Ordovician, and Silurian periods can be inferred only from the character of the rocks in other parts of the country. Such inferences possess little value and will not be attempted.

The oldest rocks exposed in the county are high up in the Pennsylvania series of the Carboniferous system, but the numerous wells drilled for oil and gas in this county have revealed the sequence and character of strata in the underlying Mississippian and Devonian.

DEVONIAN PERIOD.

The account of the geologic history begins then, with the lowest rocks penetrated by the drill. These as reported by drillers are shales and thin interbedded sandstones. They are well down in the Devonian, probably of Chemung age. Where Chemung rocks are exposed at the surface elsewhere in Pennsylvania they are largely shale, sandstone, and thin impure limestone, the shale predominating. The fossils that abound in these rocks are marine forms of animal life.

When these Devonian rocks were laid down a large part of what is now the continent of North America was covered by water, a great inland sea bounded on the north by the Archean highlands of Canada and on the east by a land area lying somewhere along the Atlantic slope and apparently crossing New England near its western line.

The land extended far to the south, and probably reached eastward considerably beyond the present Atlantic shore line. This great exposure of salt or brackish water had access to the open sea, but it did not have a fixed shore line or constant relation to the land for any great length of geologic time.

At the time this history begins the streams from land somewhere to the east were discharging great quantities of muddy sediments into this inland sea. These muds were interbedded with layers of sand. This was due probably to slight elevation of the land, which made erosion more active, or to the reworking of material already deposited.

In the midst of this long-continued deposition of alternating muds and sands, which the deepest wells show to be more than 1,350 feet thick, the streams brought to the sea a great quantity of red material, presumably derived from a deeply oxidized land area, like the soils of the South Atlantic States today. These shales and sandstones, prevailingly red in color, which came in toward the close of the Devonian, have a thickness of over 200 feet in the eastern half of the county, but in the deep wells in the western half of the county 20 feet is the maximum thickness. These red rocks, known as the Catskill beds, seem to be in lentils of variable extent and thickness where they are so thin and represent the western margin of Catskill deposition.

After the deposition of this red material the conditions which preceded it were repeated and a succession of sandy sediments was laid down in the sea. The coarser character of the material was due to the shallowness of the sea and the frequent reworkings of the material by the waves, or to the greater elevation and consequent more active erosion of the land to the east.

CARBONIFEROUS PERIOD.

POCONO EPOCH.

Fossils are the means by which the age of rock strata is determined. Since it is not possible to obtain fossils from the beds that are so deeply buried below the surface of the county, there is no way of determining just where the Devonian ends and the Carboniferous sediments begin. It is believed, however, that the Carboniferous began with the deposition of large quantities of sand, soon after the close of the time in which the red Catskill deposits were laid down in this region. This sand is the 250 to 300 feet of sandstone found in deep wells and known to geologists as the Pocono sandstone. The lowermost of these massive beds is known to drillers as the Fifty-foot sand. This and the Gantz sand were followed by gray mud and occasional red beds. Then, in the latter part of Pocono time, vast quantities of coarse sand poured into the Appalachian sea or inland gulf and formed the Burgoon, Big Injun, or Mountain sandstone. The Pocono beds in Greene County are only a fraction of the thickness of those in northern Pennsylvania; the difference in thickness may be explained by the difference in distance from the shore.

MAUCH CHUNK EPOCH.

After the close of Pocono time the sea must have become deeper and clearer, for little or no sandy sediments were deposited. Probably the submergence which brought the clear ocean waters into the region converted the lower courses of the rivers into estuaries where the coarser part of the land waste was held. The open sea contained an abundance of marine animals, and by their agency, aided perhaps by chemical precipitation, beds of fossiliferous limestone were laid down to a thickness of 40 to 80 feet. This Greenbrier limestone, or Big lime of the drillers, forms the lower part of the Mauch Chunk series. The period during which the limestone accumulated was long and free from movements of the earth's crust.

An elevation of the continent sufficient to quicken erosion and bring this region within the zone which could receive muddy sediments put an end to the deposition of the Greenbrier limestone. A quantity of mud and sand was brought into the clear sea water and sandy shales were deposited. The red color of these rocks suggests that conditions of Catskill time were repeated, that is, the red material was derived from a deeply disintegrated land surface in which the soil had by long oxidation become red.

These Mauch Chunk red shales are 100 feet thick in some Greene County wells. These sediments thicken greatly toward the east so it is probable that the land area from which they were derived lay in that direction. While the red mud was being swept far out to sea, the coarser material from the new land area was accumulated in flood-plain and coastal-plain sediments which, after being reworked, were finally deposited under the sea in the next epoch. The scarcity of fossils in the red shales above the Big Lime suggests that conditions in the sea during the deposition of this mud were unfavorable to life.

Erosion following Mauch Chunk Epoch.

The Mauch Chunk series decreases in thickness from 2,000 feet in northeastern Pennsylvania to 100 feet or less in western Greene County. Farther west it is absent. The decrease in thickness from east to west is not uniform for these beds are only 50 feet thick at Blairsville, Indiana County, and are 200 feet thick in eastern Washington County.

Facts of this nature indicate that the sea bottom from southern New York to Alabama and as far east as the Allegheny Front was raised and became land. From this land the upper part of the Mauch Chunk was carried away by stream erosion.

POTTSVILLE EPOCH.

From the work of David White on the fossil plants[1] it is now known that in the southern anthracite basin the deposition of sediments in the sea was continuous from the close of Mauch Chunk to the beginning of Allegheny time, but in the western part of the State the sea bottom was made land at the close of the Mauch Chunk epoch. The Pottsville beds are 1,200 feet thick in the southern anthracite field, mostly sandstone and conglomerate, and it was not until about 800 feet of this had been laid down in the eastern trough that the land in southwestern Pennsylvania subsided and deposition was resumed there.

The Connoquenessing sandstone or Salt sand was deposited in Greene County at this time. The basin seems to have been filled by the sediments and the resulting low-lying land covered with vegetation, which in time formed the Mercer coals. Varying amounts of mud and thin limestone were deposited in this period. These beds are exposed where the Pottsville outcrops in other regions, but it is not definitely known from the well records whether or not they occur in this county. Next, the Homewood sandstone was deposited over the region. This closed the Pottsville epoch.

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[1] White, David, Fossil floras of the Pottsville formation in the southern anthracite field, Pennsylvania: Twentieth Ann. Rept. U. S. Geol. Survey, pt. 2, pp. 751-930, 1899.

ALLEGHENY EPOCH.

The deposition of the Homewood sandstone was followed by that of the Allegheny group. This group is composed of shales, sandstones, limestones, and coal beds, and has long been known as the Lower Productive Coal Measures because it contains the oldest of the important coal beds.

This group is nowhere exposed at the surface in Greene County, but the sequence of geologic events as shown by the rock strata can be inferred from the sequence of these rocks seen in adjoining territory and from the records of wells in this county. The great variations in material indicate that this area was alternately near shore, deep sea, and barely submerged, or that the sea repeatedly was filled and the bottom sank or the bottom alternately rose and subsided.

As soon as Pottsville submergence ceased the top of the sand last deposited was covered with a few feet of clayey sediments. Then the sea bottom rose approximately to water level and an extensive marsh was formed in which strange forests throve and laid down their remains in peat bogs. From time to time different parts of the marsh were overflowed and fine sediment was deposited over the peat. This sediment now forms the partings or binders of the coal bed. After a long period in which the earth's crust was stationary and many feet of vegetal matter had accumulated in the marsh, the region again was submerged and the vegetal matter buried under sediments. The weight of these sediments compressed the vegetal deposit and eventually it was hardened into the Brookville coal. When the basin was filled with mud then another forest spread over the new marsh and the Clarion coal was laid down. A crustal submergence of broad extent spread the beach and flood-plain sands over the coal marsh and formed the Clarion sandstone. A greater submergence followed, and as a result the region was farther from shore. In this deep water muds were laid down, and then the Vanport (Ferriferous) limestone, which carries a marine fauna. When the muds which include the limestone were built up to water level a rank growth of vegetation developed upon the surface and the Lower Kittanning coal was formed.

During the Allegheny epoch this sequence of events recurred a number of times, so that in some districts from five to ten coal beds were formed. Each coal bed represents a period of long quiet with the sea filled with sediments and marsh conditions prevailing; each sandstone marks a subsidence; each shale and limestone means that the area was deeply submerged, quiet water far from shore. Although the sea bottom undoubtedly was elevated at times, the prevailing movement was subsidence. The Allegheny epoch ended with the subsidence of the widespread marsh in which uniform conditions favorable for the growth of vegetation had produced the peat bogs that later became the Upper Freeport coal.

CONEMAUGH EPOCH.

The Conemaugh epoch was characterized by more nearly continuous subsidence of the sea bottom than in the Allegheny epoch, for 600 feet of sediments accumulated with only a few minor seams of coal. The beginning of Conemaugh time is marked by a widespread submergence which carried the Upper Freeport coal below the surface and buried it beneath a thick deposit of sand which is known where it outcrops as the Mahoning sandstone and to drillers as the Big Dunkard sand. Locally this sand deposit filled the basin to the surface and upon it vegetation grew for a short time, furnishing the material for a thin coal seam.

Further subsidence brought in more sands to form the Saltsburg sandstone. In some places the subsidence was continuous for so long a time that the lower portion is 150 feet of almost continuous sandstone. In general the rest of the Conemaugh consists of shales with occasional heavy beds of sandstone. The Ames limestone, which occurs about the middle of the group and is spread over wide areas in western Pennsylvania and eastern Ohio, contains abundant marine fossils, showing that deep salt water covered the area at that time. This limestone is supposed to mark the last recurrence of marine conditions in the Appalachian coal basin.

The Morgantown sandstone, which lies above the Ames limestone, indicates a period of marked elevation during which the previously accumulated coastal plain deposits were transferred into the sea. Red shale overlies the Morgantown sandstone in many places and seems to record a period when the adjoining land lay near sea level so long that its surface was deeply disintegrated and its soils deeply oxidized, as in the Catskill and Mauch Chunk epochs. This fine red land waste filled the sea with mud until seaward tilting carried in more sand. The Connellsville sandstone was deposited during this tilting. There followed a period of submergence when the deposition of fine sand alternated with clay and limy mud. Slow sedimentation continued until finally the bottom of the greater part of the basin was brought near water level and the Conemaugh epoch ended.

The upper half of the Conemaugh group is exposed in the bluff along Monongahela River from the mouth of Dunkard Creek to the West Virginia line. These are the oldest rocks showing at the surface in Greene County.

MONONGAHELA EPOCH.

The Pittsburgh coal at the base of the Monongahela group is the lowest coal bed outcropping in Greene County and the geologic history from the time of its deposition can be inferred from rocks seen somewhere within the county.

At the close of Conemaugh time the Appalachian basin was filled with sediments and the sea excluded. It was a level land area close to sea level. The Monongahela epoch began with the development of the characteristic Carboniferous flora over this wide area, and remarkably uniform conditions persisted in for a long time resulted in the accumulation of a great thickness of vegetal matter in the form of peat. Such changes as took place—for example, the deposition of thin layers of mud over the peat—were also widespread in their extent. The swampy conditions were finally ended by a broad submergence, which caused the deposition of mud and sand over the great peat bog. The peat was compressed and changed to coal and the thin deposits of mud became the partings in the coal. When the submerged basin was again filled with sediments, including thin limestone and shale on top of much sand, swamp conditions recurred in places and here developed the luxuriant forests which later formed the Redstone coal.

After the growth and deposition of the Redstone coal vegetation, the land sank and limestone was formed in the clear water. Land sediments then filled up the basin and formed the surface on which grew the forests that furnished the material from which the Sewickley (Mapletown) coal was derived. Again came a period of submergence, with clear water conditions for a long period, in which was formed 150 feet of limestone with a few shales. This is the Benwood (Great) limestone that outcrops below Rices Landing and between Jefferson and Millsboro.

After the deposition of the Uniontown coal immediately on top of this limestone there was further submergence and shale and sandstone were laid down. Then the water cleared, possibly becoming deeper, and the Waynesburg limestone was formed. After the deposition of more shale the waters became shallow and conditions favored the growth of another great forest. From this vegetal covering the Waynesburg coal originated. The accumulation of this bed was frequently interrupted by incursion of thin deposits of mud. The final interruption of vegetal growth and burial of this swampy area ended Monongahela time.

DUNKARD EPOCH.

The Dunkard epoch began with another submergence which was accompanied in some places by the deposition of several feet of mud on top of the Waynesburg coal vegetation, but which in general caused a sand to be spread over the basin to a depth of 40 to 70 feet. The Waynesburg sandstone, as it is known, filled the basin again and formed the surface on which the Waynesburg A coal was laid down. The formation of this coal as usual was stopped by submergence which permitted the accumulation of shale, sandy shale, or limestone, according to the varying depth and character of the waters. At intervals the basin was filled and peat bogs formed, the forerunners of coal beds; again the waters were clear and teamed with minute animal life whose remains are now found in the thin limestones. The Washington coal represents an extensive swampy area covered with luxuriant vegetation, and the numerous partings in the coal tell of frequent muddy inundations of the swamp. The Lower Washington limestone directly on top of this coal indicates clear or deep waters and abounds in small fossil shells. Above it there are several hundred feet of rocks which are mostly shale and sandy shale, but which contain occasional thin limestones and coals, and local sandstones. In western Greene County red shales are of frequent occurrence in the Dunkard group, indicating deep weathering of the surface rocks of the adjacent land areas from which these muds were washed into the basin. Sedimentation probably continued until the Appalachian gulf or inland basin was finally filled. This ended the Paleozoic sedimentary record in this part of the world.

APPALACHIAN REVOLUTION.

Ever since the beginning of sedimentation in the Appalachian basin, subsidence had been more or less continuous and with renewed elevation of adjacent land areas, resulted in the accumulation of thousands of feet of strata. The Dunkard epoch and the Carboniferous age closed with a reversal of general movement of the earth's crust. Elevation has been the prevailing movement in this area since the Dunkard epoch and dry land has existed continuously since that time. This change from subsidence to uplift introduced a period in which stresses and strains in the earth's crust bent the rocks into great folds. The compressive strains were so severe in southeastern Pennsylvania that the rocks were not only intensely folded and crumpled but the pressure was so great that cleavage was induced and in many cases the rocks were completely changed in character and appearance. Westward from this zone to the Allegheny Front the strain was less severe and the folds were of smaller size. In a measure the Appalachian coal basin seems to have acted as a bulwark against which the rocks were crushed. The folding continued, however, across the basin, but with greatly decreased effect. Some of these low folds are seen in the anticlines and synclines of Greene County. The period of uplift and compression which produced these folds is known as the Appalachian revolution.

MESOZOIC ERA.

The Appalachian region has been a land area during all of Mesozoic and Cenozoic time. During Mesozoic time erosion is believed to have reduced the surface of the State almost to a plain, lying close to sea level. To reduce the surface to a fairly common level, regardless of the character of the underlying rocks, was a slow process and required an exceedingly long time. After its formation, which probably occupied much of the Cretaceous period, this gently undulating surface, called the Schooley peneplain, was elevated and the streams at once began to cut into it. It is thought that the tops of the even-crested ridges in the central part of the State are remnants of this peneplain or only slightly below it. It is believed that the plain was uplifted unevenly and that the surface sloped westward in this part of the State. If this plain be projected westward from the areas on the east where it seems to be represented by level summits of about the same altitude, its probable altitude in Greene County would be about 1,600 feet above sea level. Curiously it is found that many hilltops on the divide between Ohio and Monongahela drainage in western Greene County from New Freeport to Time are between 1,550 and 1,660 feet above sea level. As the similarity in altitude of the hilltops is not in accord with the structure of the underlying rocks, may these hilltops be interpreted as representing remnants of an old peneplain of which none is left but the summits of a few hills, or is the old surface all gone and these hilltops that are so nearly the same height are below its level but approximately parallel with it? Another possibility is that these numerous hilltops at about the same level in the western part of the county represent some other plain at a generally lower level but here warped up to 1,600 feet.

CENOZOIC ERA.

TERTIARY PERIOD.

Following the period of long-continued erosion in Cretaceous time during which the Schooley peneplain was produced, this region was uplifted not less than 800 feet above sea level and the streams, given increased grades, began active erosion of the surface. During the period of erosion the harder rocks on the greater folds, like Chestnut

Ridge, were left in relief, while the softer rocks were again reduced to a fairly common level. This surface is now represented by the hilltops which stand at an altitude of 1,200 to 1,300 feet above sea level. If there are any remnants of this peneplain in Greene County they should be at an altitude of about 1,250 feet. Rare divides and small flat spurs do occur at this elevation in the eastern part of the county and at higher elevations westward. If we assume that this old plain rose to the west, due to warping, the 1,500- and 1,600-foot hilltops in the western part of the county may be a part of it.

After the formation of this peneplain, the surface was again raised, and again dissection began to destroy evidence of the existence of a plain. The succeeding stages of development are not well enough marked in Greene County to warrant discussion. There are traces of a surface about 100 feet lower, consisting of flat-topped spurs at an elevation of about 1,150 feet in the eastern part of the county. Its date of origin was probably in late Tertiary time.

The widening of this erosion surface had not progressed far when it was interrupted by another elevation of the earth's crust and renewed dissection by the streams. This was followed by a brief period of tranquillity, during which the streams widened their valley floors. The broad rock benches along Monongahela River at elevations of 900 to 1,050 feet and the terraces at Jefferson were formed at this time. The erosion stage probably marked the close of Tertiary time, for on it are found the deposits of the first stage of the glacial epoch.

QUATERNARY PERIOD.

Another slight elevation of the land at the close of the Tertiary period caused the larger streams to cut channels in the bottoms of the broad valleys mentioned above. At that time Monongahela River discharged its waters through Beaver Valley into Lake Erie, but when the first great continental ice sheet of Pleistocene glaciation advanced into northern Pennsylvania, the waters of north-flowing streams formed a lake along the ice front and the streams were ponded for a considerable distance toward their headwaters. The silting up of Allegheny River raised its bed so high that the Monongahela was ponded and in its standing water were deposited the clays, sands, and gravels known as the Carmichael formation, now lying in abandoned channels and on terraces in the eastern part of the county at 950 to 1,050 feet above sea level.

Since that time the level of the region has remained substantially as at present and the down-cutting of stream channels has been practically continuous.

MINERAL RESOURCES

COAL.

Coal is the most important mineral resource of Greene County. This statement may be questioned by some people who are familiar with the great expenditures for drilling oil and gas wells, for pump stations and pipe lines, and who know of the royalties received by many farmers from this industry. The assertion is based on the fact that the great Pittsburgh coal bed underlies the whole county and as yet has been mined only along Monongahela River. The coal mining industry in Greene County is small at present in comparison with what it may be when broad-gauge railroads cross the county and shafts to the Pittsburgh coal are sunk in every township.

Of the numerous coal beds outcropping in the county, three are of workable thickness, the Pittsburgh, Sewickley, and Waynesburg. The outcrop lines of these beds are shown on the geologic map, together with structure contours on the Pittsburgh coal. The correct representation of the underground structure is almost as important to coal mining as it is to the gas and oil industries. The importance of an accurate representation of the lay of the coal is understood when it is considered that, for advantageous working of a mine, drifting should be carried up the slope. A mine entry should be so located with relation to the dip of the bed that all mine water will drain out naturally and loaded cars will have a down grade. When a coal mine is worked from a shaft the bottom of the shaft should be at the lowest point on the body of coal to be taken out. From the structure contours drawn on the Pittsburgh coal bed in this county may be determined the direction in which drifts should be driven from the bottom of any shaft that may be sunk to the coal, in order to get natural drainage to the sump and a favorable grade for moving coal toward the shaft.

In the description which follows some measurements of coal beds are by the writer, some were made by L. D. Woodworth who was employed by this Survey to collect samples of coal for analysis, and some are furnished by C. P. Byrne and Edward E. Girod, mine inspectors for the 21st and 23rd districts, respectively. The order of description will be from north to south and east to west.

PITTSBURGH COAL.

The most valuable bed of coal in southwestern Pennsylvania is the Pittsburgh. It is well known for its excellent qualities as a first-class steam, gas, and coking coal. Much of this coal bed, as originally laid down, has been removed by erosion, but it still underlies 2,000 square miles in this part of the State. Figure 17 shows its areal extent and that Greene County is wholly within the Pittsburgh coal field.

In Greene County the Pittsburgh coal outcrops only at water level on Tennile Creek below Clarksville for less than a mile, on Monongahela River above Grays Landing, and on the lower part of Dunkard Creek. Well records show that the bed is present throughout the county. On the outcrop it is developed by drifting, and at other points on the river it is reached by shafts. To develop this coal away from the river where it is under deep cover, shafts must be sunk. It is 250 feet below creek level at Mather, 650 feet at Ruff Creek, 500 feet at Waynesburg, 600 feet at Kirby, 830 at Nineveh, 350 at Ryerson Station, and 800 at New Freeport.

Of its quality as a steaming and domestic coal nothing need be said, for it is widely and favorably known. It is a high producer of illuminating gas, containing sometimes 36 to 38 per cent of volatile combustible matter. For the manufacture of coke the Pittsburgh coal has few if any equals in the United States. It is persistently from 6 to 9 feet thick and of good quality, as has been proved by drill holes, and on the basis of such evidence large acreages have been acquired by steel corporations.

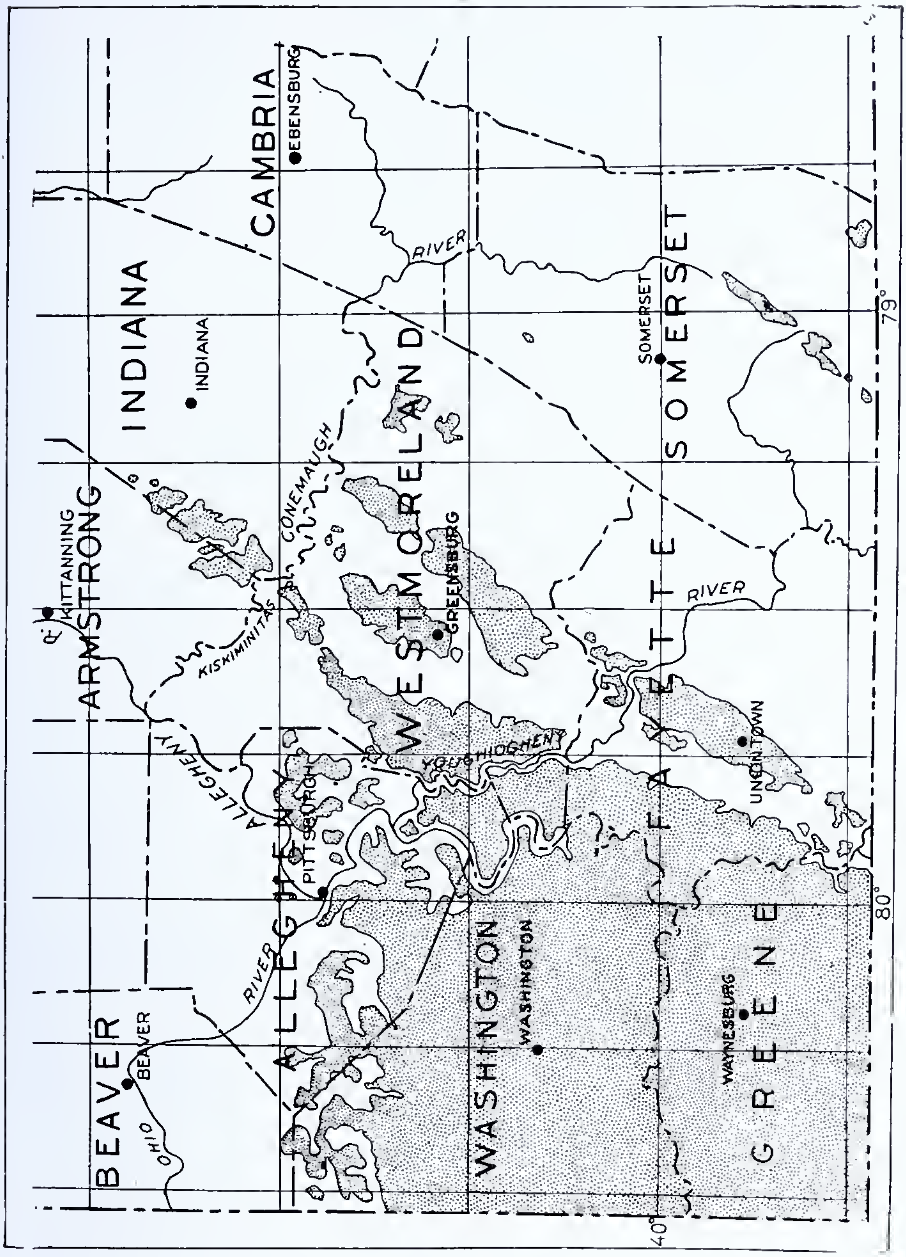

Fig. 17. Map showing the area of the Pittsburgh coal in Pennsylvania.

The physical character of the Pittsburgh coal bed is shown by the measurements given in the description of each mine, and its chemical character by the analyses tabulated at the end of this description.

In Greene County, as is common in all western Pennsylvania, the coal is mined by the room and pillar method. According to J. D. Sisler[1] "The entries are driven 10 feet wide. Rooms range from 15 to 24 feet wide, and room pillars from 15 to 90 feet wide. Room necks are 21 feet long and 10 feet wide. Chain pillars are 40 feet wide, and barrier pillars from 150 to 200 feet. The room breakthroughs are 60 to 105 feet apart, and from 10 to 12 feet wide. Pillars are fairly well recovered in this district. The recovery of coal along the western bank of Monongahela River has increased greatly within the last few years. When this district was opened up it was customary to leave as much as 2 feet of top coal to hold up the roof, and from 1 to 3 inches on the bottom which was slightly inferior to the excellent middle bench. When demand for coal was slight the fine sizes were discarded on the dump and only the lump coal loaded. The recovery was probably less than 50 per cent. At the present time the greatest loss is in pillar pulling. The pillars are slabbed and split and rather large sized stumps are left. The smaller companies sometimes leave up head coal to minimize timbering costs. Machine men cut from 2 to 5 inches above the bottom and the coal under the cut is seldom scrapped.

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[1] Sisler, J. D., Bituminous coal losses and mining methods in Pennsylvania: Pennsylvania Top. and Geol. Survey, Bull: M4, p. 65. 1924.

"In the vicinity of Dunkard Creek the Pittsburgh bed is inclined to be faulty, and thins very rapidly. Large areas of thin coal, which cannot be profitably removed at present, are driven around and lost entirely. This coal would have great future value after the thicker portions of the Pittsburgh bed have been exhausted."

Greene County contains approximately one-quarter of the reserve of Pittsburgh coal in the State. The presence of the bed has been proved even where it lies 800 feet below the surface. Large iron and steel companies in recent years have bought up this coal in Greene County as a reserve for the future production of coke (See page 115).

Byetheway mine. On the south bank of Tenmile Creek at its mouth and about 1,500 feet southwest of the railroad station at Millsboro is the drift mine of the Byetheway Coal Company of Millsboro. The coal is practically at water level and mine cars are pulled up grade onto a trestle for dumping into barges. Mining is by machine and an output of 200 tons per day can be made. In April 1924 one acre had been exhausted and 8 acres remained. An average section of the bed in this mine is: Roof shale, top bench 36 inches, bearing-in bench 4 inches, bottom bench 38 inches, floor fire clay. The partings between the benches are about ¼ inch thick. An average of 6 feet 6 inches of clean coal is present.

Another mine owned by the John Eddy Coal Company of Buffalo, leased and operated by David N. Malone, was ½ mile west of the Byetheway mine at the south end of the iron bridge over Tenmile Creek on highway route No. 268. The coal bed here is nearly 7 feet thick, but the bottom foot of coal carries an excessive amount of sulphur. This mine ceased operating several years ago.

Clyde No. 2 mine. W. J. Rainey, Inc., Uniontown, Penna., has a mine at Trumbull, a small village on the south bank of Tenmile Creek opposite Besco and one mile below Clarksville. Although the mine slope is in Greene County, all the mining is done on the north side of the creek in Washington County. The coal outcrops at the mine but is 32 feet below the creek where the main heading crosses the county line. Mine cars are hauled by mules and by main and tail rope to the Greene County side and back over the creek on a steel bridge to a tipple on the Monongahela Division of the Pennsylvania Railroad. The mining equipment includes 1 chain breast and 4 short wall machines. Electric power is purchased. Sizes shipped are run-of-mine, slack, nut, and lump, prepared on shaker screens. About 150 men are employed.

In 1930 the average output was 1,140 tons per day for 182 days, with 280 men employed. The mine was sampled and measurements were made at four points by L. D. Woodworth, January 27, 1922. It was then the Trumbull mine of the Trumbull Coal Co.

Sections of coal bed in Trumbull or William Pitt mine.

Section	A		B		C		D	
Laboratory No.	83976		83977		83978		83979	
	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.
Coal	3	5½	3	8	3	10	3	9
Slate*		½		½		½		½
Coal		3		3		3		3
Slate*		½		½		½		½
Coal	2	7	2	6½	2	3	2	4
Floor coal*		4		4		3	----	----
Thickness of bed	6	8½	6	10½	6	8	6	5
Thickness of sample	6	3½	6	5½	6	4	6	4

*Not included in sample.

Edward mine. On the bank of Tenmile Creek ¾ mile southwest of Clarksville and opposite the mouth of Castile Run is the Edward mine of the Chartiers Southern Coal Company. The shaft is on the flood plain and beside the Pennsylvania Railroad. The lower beds of the Benwood limestone are exposed at track level and depth of the shaft to the bottom of the coal is 133 feet. This mine was opened in 1921. Coal is cut by short wall machines and hauled to the shaft by mules. Power equipment consists of one 150 hp. fire tube boiler and one 100 kw. generator, 250 volts d.c. In 1930 this mine employed 192 men for only 46 days, producing about 1,050 tons daily. The product, is run-of-mine, slack and lump, prepared on bar screens. A 10-inch draw slate separates the main bed and a one foot rider. The roof is shale and the floor is fire clay. The mine was sampled and measurements made at three points by L. D. Woodworth on January 18, 1922.

Sections of coal bed in Edward mine.

Section	A		B		C	
Laboratory No	83846		83847		83848	
	Ft.	in.	Ft.	in	Ft.	in.
Coal	3	5	3	5	3	4
Slate*		½		¼		¼
Coal		2		2		3
Slate*		¼		¼		¼
Coal	3	0	2	7	2	7
Floor coal*		6		6	1	0
Thickness of bed	7	1¾	6	8½	7	2½
Thickness of sample	6	7	6	2	6	2

*Not included in sample.

The Edward mine was acquired by the Emerald Coal & Coke Co., in 1930 and is now the Emerald mine.

Mather collieries. Pickands, Mather & Company of Cleveland, Ohio, began the development of a mine on the north bank of Tenmile Creek opposite Jefferson in 1917. Where a few years ago was meadow land there was in 1925 a settlement of 2,000 people occupying 325 houses. The railroad was completed to Mather in June 1918 and the first coal was shipped in the winter of 1918-19. Two shafts have been sunk to the Pittsurgh coal at a depth of 348 feet. Mine haulage is by mules, two trolley pole and eight storage battery locomotive. Mining is done by 15 shortwall machines and on the panel system. The colliery is operated by purchased electric power. All coal is prepared on picking tables and shipped as run of mine. This colliery produced about 3,900 tons daily for 268 days in 1930, with 782 men employed. The company holds 4,500 acres of the Pittsburgh bed.

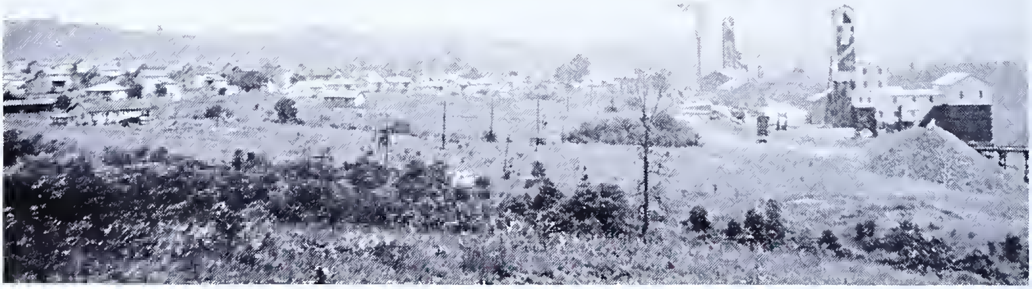

Fig. 18. Village of Mather and the Pickands, Mather & Co. mine, on a terrace of Tenmile Creek.

The bed was measured and sampled at six points by L. D. Woodworth on January 13, 1922.

Section of coal bed in Mather mine.

Section	A		B		C		D		E		F	
Laboratory No.	83771		83772		83773		83774		83775		83776	
	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.
Bony coal*		4		3½		5				3		3
Coal	2	5	2	6	3	2	2	5½	3	1	1	5
Bony coal*		1										
Slate			*	½		¼		¼				
Mother coal												¼
Coal		8		7½		3		2			1	10
Slate	*	½	*	½	*	½	*	½		¼		¼
Coal		2		3		8		8		2		2
Slate	*	½		¼		¼		¼		¼	*	½
Coal	2	10	2	7½	2	5½	2	0	2	10	2	4½
Bottom coal*		4										
Thickness of bed	6	11	6	4¾	7	½	5	4½	6	4½	6	1½
Thickness of sample	6	1	6	¼	6	6½	5	4	6	1½	5	10

*Not included in sample.

Dilworth mine. The H. C. Frick Coke Company mines the Pittsburgh coal at Rices Landing by means of a shaft 168 feet deep. The bed is about 100 feet below the river. Mining is by hand and two electric machines. Haulage is by mules and two electric locomotives. Power is developed by 4 return tubular boilers, total 600 hp., and two 150 kw. generator units, 250 volts d.c. The Monongahela Division of the Pennsylvania Railroad passes the shaft but all shipments are by river barge. The output of the mine when operating is about 800 tons daily. It was idle from April 1925 to January 1928 because of the condition of the coke industry. This mine produced over 100,000 tons in 106 days in 1928 but was idle in 1929-30. Shaft No. 2 of this mine is at Dry Tavern, a mile from the river. The Waynesburg coal is 65 feet below the surface and the Pittsburgh coal

440 feet in this shaft. This shaft is for men and supplies only. The mine extends 1½ miles southwest of this shaft, or nearly to the borough limits of Jefferson. This is the oldest commercial mine on the Pittsburgh coal in Greene County, having been opened about 1898.

The roof is shale and floor fire clay. The bed was sampled and measured at five points by L. D. Woodworth on January 20, 1922.

Sections of coal bed in Dilworth mine.

Section	A		B		C		D		E	
Laboratory No.	83892		83893		83894		83895		83896	
	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.
Coal	3	9	3	9	3	5	3	8	3	11
Slate		¼		¼		⅛		¼	*	½
Coal		2		3		4		3		4
Slate	*	½		¼		¼		¼	*	½
Coal	1	5½	1	6	2	9	2	7	2	8
Slate	*	½		¼	----	----	----	----	----	----
Coal	1	2	1	1	----	----	----	----	----	----
Floor coal*		4		5		3		5		4
Thickness of bed	6	11¾	7	¾	6	9⅜	6	11½	7	4
Thickness of sample	6	6¾	6	7¾	6	6⅜	6	6½	6	11

*Not included in sample.

Crucible mine. On the south bank of Monongahela River at Arensburg ferry 2 miles east of Riees Landing is the Crucible mine of the Crucible Fuel Company of Pittsburgh. The shaft is 150 feet deep to the coal which is 120 feet below the river. Mining is done with 18 electric machines, and the coal is hauled to the shaft by 6 gasoline locomotives. It is prepared on bar screens and picking table and shipped as run-of-mine, slack, and lump by the Monongahela Division of the Pennsylvania Railroad. The mine was opened about 1912. About 755,000 tons were mined in 1930 by 566 men in 220 days. Five hundred acres have been mined out and about 5,000 acres are in reserve.

Power is supplied by 6 water tube boilers with a total capacity of 1.500 hp. and by 3 generator units, 250 volts d.c.

The floor of the coal bed is rather soft clay, and the roof is variable. Draw slate where present runs up to 12 inches thick. In some places a 10-inch roof coal is present and no draw slate, or both may be absent and sandstone forms the roof.

The bed was measured and sampled at six points by L. D. Woodworth on February 6, 1922.

Sections of coal bed in Crucible mine.

Section	A		B		C		D		E		F	
Laboratory No.	84169		84170		84171		84172		84173		84174	
	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.
Coal	2	5½	3	6	1	6	3	10½	4	3	5	1
Slate	*	1	----	----	----	----		¼		¼		⅛
Bony coal*	----	----		3	----	----	----	----	----	----	----	----
Sulphur*	----	----	----	----		½	----	----	----	----	----	----
Coal	1	9		2	2	8		3½	2	2		4
Slate		¼	*	½		¼		¼	----	----		¼
Coal	2	5½	2	8	2	2	2	3	----	----	1	3
Floor coal*	1	0	1	0	1	0	1	0	1	0	1	0
Thickness of bed	7	9¼	7	7½	7	4¾	7	5½	7	5¼	7	8⅜
Thickness of sample	6	8¼	6	4	6	4¼	6	5½	6	5¼	6	8⅜

*Not included in sample.

Nemacolin mine. The new mining town of Nemacolin, built since the World War, is 3 miles southeast of Carmichaels just below Parkers Bar on Monongahela River. The mine is operated by the Buckeye Coal Company of Youngstown, Ohio, in the interest of the owners, Youngstown Sheet and Tube Company. It has a slope 270 feet deep to the coal and two shafts, all on the Pennsylvania Railroad. The coal is about 230 feet below the river. It is mined by shortwall and top-cutting machines, and compressed air drills, and hauled by mules, 4 trolley pole and 12 storage battery locomotives. Electric power is purchased and the plant also has 3 water tube boilers totaling 800 hp. and two 50 kw., m.g. sets, 250 volts d.c.

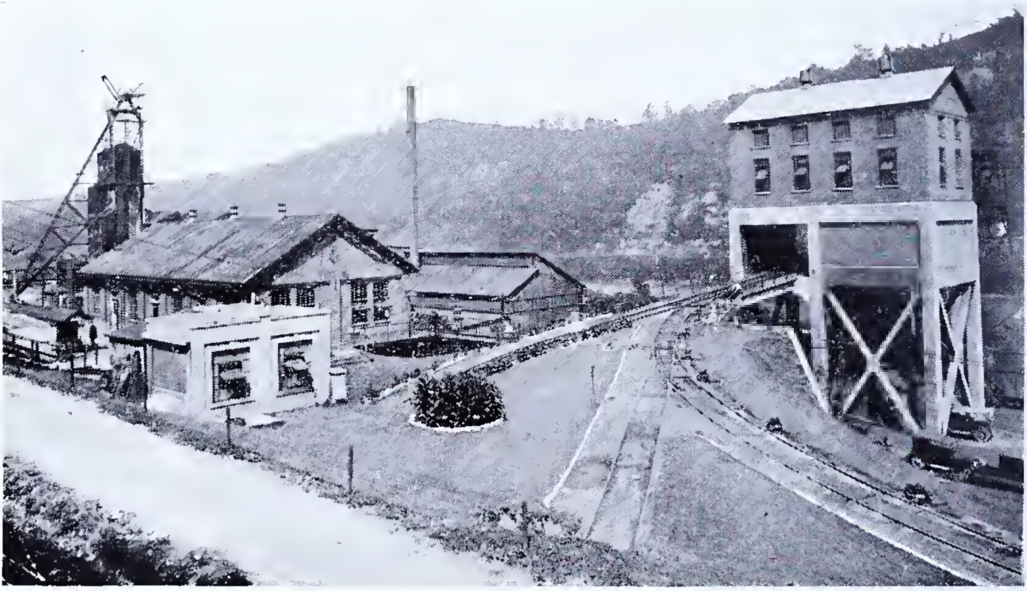

Fig. 19. Nemacolin mine on Monongahela River.

The haulage ways of the Nemacolin mine were rock-dusted in 1924. This is the first mine in Greene County to be protected in this manner. All working faces are supplied with hose and water to wash down the face, and all undercutting machines are equipped with watering devices for sprinkling the cutter bars.

The coal is shipped as run-of-mine, and in 1930 the plant produced 1,414,000 tons in 203 days, or nearly 7,000 tons daily, with 1,074 men employed.

The underground workings extend about 3 miles along the river and 2 miles back under Greene County. The company owns about 8,400 acres at this mine.

About 10 feet of shale overlies the coal, also 6 to 8 inches of roof coal and 6 to 12 inches of draw slate. In most places the draw slate is not handled and 6 inches of the main coal bed is left up for roof. Several inches of bottom coal usually is left down also for the floor is soft clay.

The coal bed in this mine was measured and sampled at six points by L. D. Woodworth on February 9, 1922.

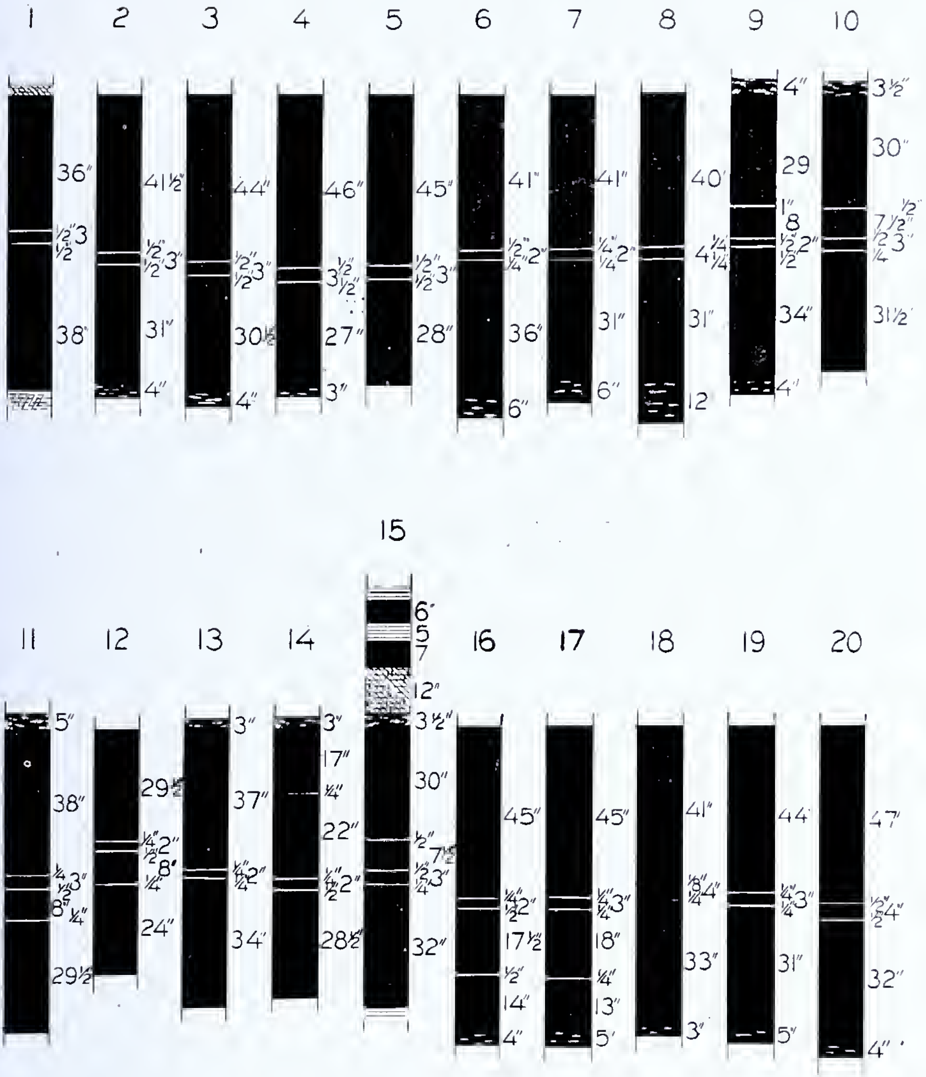

Fig. 20. Sections of Pittsburgh coal bed.

Sections of Pittsburgh coal bed.

1. Byetheway mine, mouth of Tenmile Creek. Byetheway Coal Co.
2–5. William Pitt mine, Trumbull. Pitt Coal Co.
6–8. Edward mine, Clarksville. Chartiers Southern Coal Co.
9–15. Mather No. 1 mine, Mather. Pickands, Mather & Co.
16–20. Dilworth mine, Rices Landing. H. C. Frick Coal Co.
21–26. Crucible mine, Crucible. Crucible Fuel Co.
27–32. Nemacolin mine, Nemacolin. Buckeye Coal Co.
33–37. Alicia No. 2, Grays Landing. Pittsburgh Steel Co.
38–41. Warwick mine, Greensboro. Warwick Coal Co.
42–45. Rosemary mine, Greensboro. Penn-Pit Coal & Coke Co.
46. Gabler No. 1 mine, Greensboro. Vulcan Coal Co.
47–50. Rose mine, Greensboro. Seventh Pool Coal & Coke Co.
51–55. Poland No. 3 mine, Dunkard Creek. Poland Coal Co.
56. Mabel No. 1 mine, Dunkard Creek. Mabel Coal Works.
57. Shannopin mine, Dunkard Creek. Shannopin Coal Co.
58–61. Dunkard No. 2 mine, Dunkard Creek. Mapel-Sterling Coal Co.
62–65. Moffitt mine, Dilliner. Moffitt-Sterling Gas Coal Co.
66. Walnut Hill mine, West Point Marion. West Point Marion Coal Co.
67–69. Jeannette mine, West Point Marion. Greene County Coal & Coke Co.

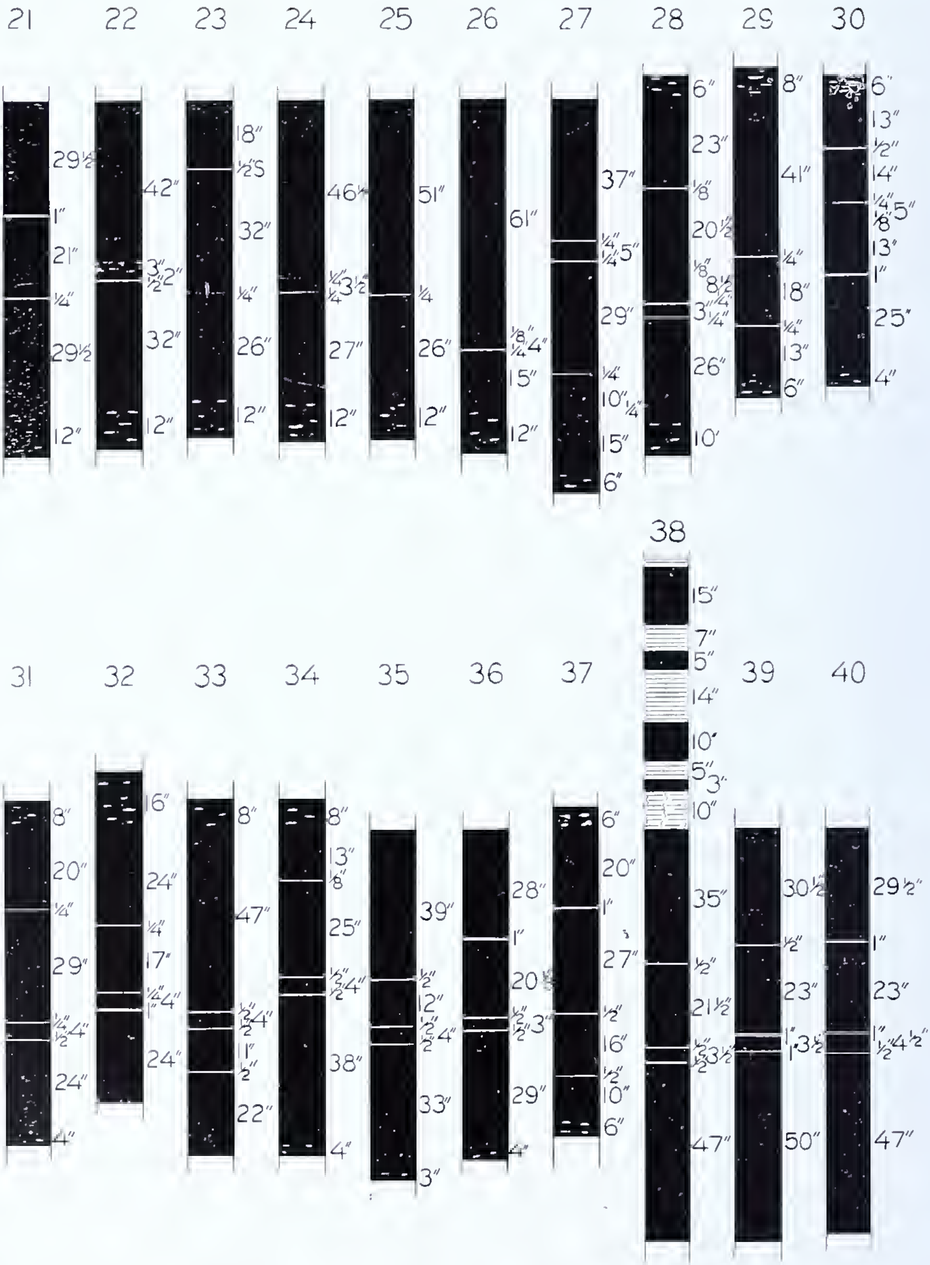

Fig. 21. Sections of Pittsburgh coal bed.

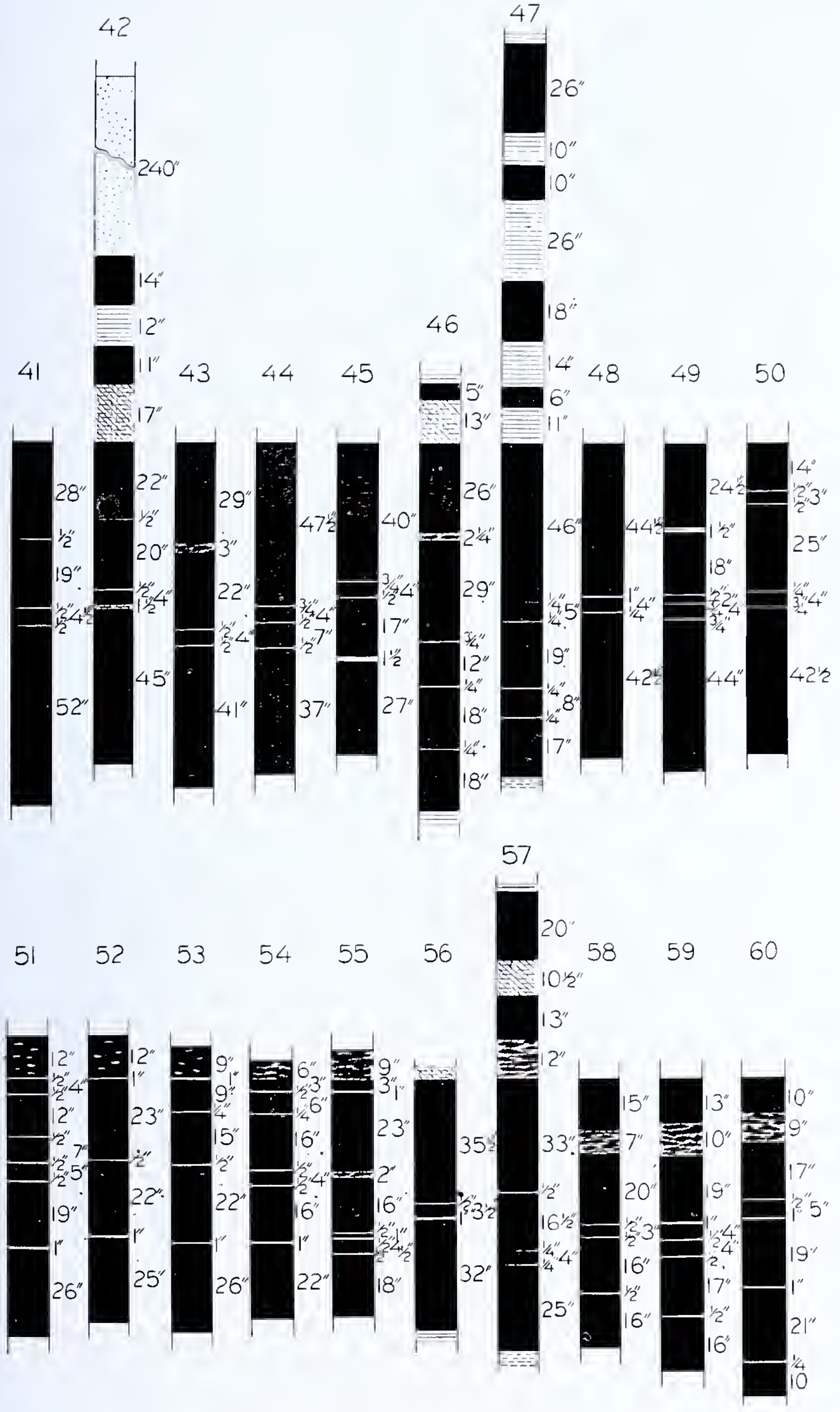

Fig. 22. Sections of Pittsburgh coal bed.

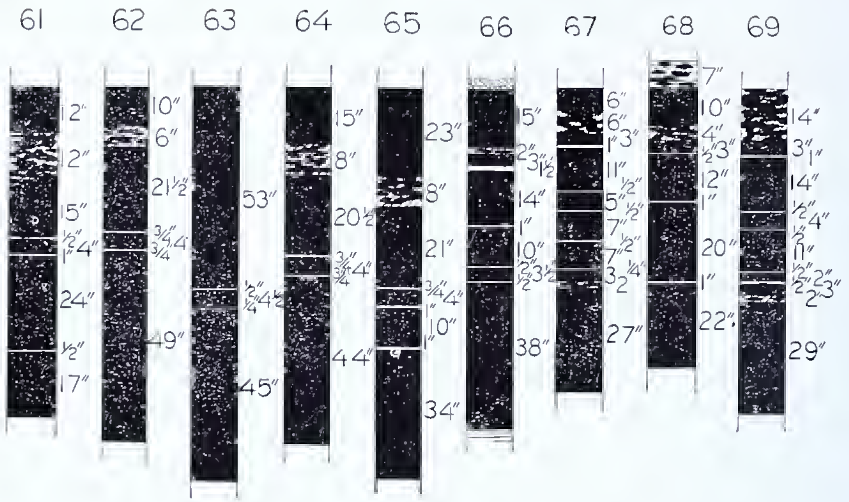

Fig. 23. Sections of Pittsburgh coal bed.

Sections of coal bed in Nemacolin mine.

Section	A		B		C		D		E		F	
Laboratory No.	84162		84163		84164		84165		84166		84167	
	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.
Roof coal*	----	----		6		8		6		8	1	4
Coal	3	1	1	11	3	5	1	1	1	8	2	0
Slate		¼		⅛		¼		*½		¼		¼
Coal		5	1	8½	1	6	1	2	2	5	1	5
Slate		¼		⅛		¼		¼		¼		¼
Coal	2	5		8½	1	1		5		4		4
Slate		¼		¼	----	----		⅛		*½		*1
Coal		10		3	----	----	1	1	2	0	2	0
Slate		¼		¼	----	----	*	1	----	----	----	----
Coal	1	3	2	2	----	----	2	1	----	----	----	----
Floor coal*		6		10		6		4		4	----	----
Thickness of bed	8	6	7	9¾	7	2½	6	9⅞	7	6	7	2½
Thickness of sample	8	0	6	9¼	6	½	5	10⅜	6	5½	5	9½

*Not included in sample.

Alicia No. 2 Mine. The drift mine of the Monessen Coal & Coke Company known as Alicia No. 2 is on the west bank of Monongahela River just below the former site of Lock No. 7, two miles below Greensboro. Mining was formerly through a slope at the present power house but is now by a drift 1,000 feet south where the coal outcrops in a small ravine. Three electric machines are used for cutting the coal, and haulage is by two electric locomotives. Power is provided by 3 water tube boilers rated at 1,125 hp., and generator units. 162 men were employed in 1930 and the output was 197,661 tons in 263 days. Shipment is by river barge only. The company holds 2,000 acres of which about 200 acres have been mined out.

Above a 12 to 18-inch draw slate there is 6 to 10 inches of roof coal. A few inches of the main bed is left up for roof but in many places falls have occurred making the rider coal the immediate roof. The floor is hard clay. Numerous clay veins from 2 to 25 feet in length in places completely cut out the coal.

Samples of the Pittsburgh coal in this mine were taken by L. D. Woodworth on February 14, 1922.

Sections of coal bed in Alicia No. 2 mine.

Section	A		B		C		D		E	
Laboratory No.	84203		84204		84205		84206		84207	
	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.
Roof coal*		8		8						6
Coal	3	11	1	1	3	3	2	4	1	8
Bony coal* or slate		½		⅛		½		1		1
Coal		4	2	1	1	0	1	10⅛	2	3
Slate*		½		½		½		½		½
Coal		11		4		4		3	1	4
Bony coal or slate*		½		½		½		½		½
Coal	1	10	3	2	2	9	2	5		10
Floor coal*				4		3		4		6
Thickness of bed	7	9½	7	9⅛	7	8½	7	4⅛	7	3
Thickness of sample	7	0	6	8	7	4	6	10⅛	6	1

*Not included in sample.

Warwick mine. The mine of the Warwick Coal Company, about 1 mile north of Greensboro, was opened early in 1922. It is a drift 77 feet above the river in a steep bluff. The company has 500 acres of coal land, of which only a few acres have been exhausted. Roof and floor are the same as in neighboring mines. Mining is done by machines and shipment is by river barge. The mine, formerly operated by the Hillman Coal Co., was operated by the Penn-Pitt Coal & Coke Co. in 1930. It has a capacity of 800 tons daily, but was worked only 31 days in 1930, producing 8,885 tons.

The following measurements were made by E. E. Girod, State mine inspector, on May 20, 1922.

Sections of Pittsburgh coal bed in Warwick mine.

	A		*B*		*C*		*D*	
	Ft.	*in.*	*Ft.*	*in.*	*Ft.*	*in.*	*Ft.*	*in.*
Blue slate	4	2	..	...	..	...	..	..
Coal	1	3	..	...	..	...	..	..
Shale	..	7	..	...	..	...	..	..
Coal	..	5	..	...	..	...	..	..
Shale	1	2	..	...	..	...	..	..
Coal	..	10	..	...	..	...	..	..
Slate	..	5	..	...	..	...	..	..
Coal	..	3	..	...	..	...	..	..
Draw slate	..	10	..	...	..	...	..	..
Coal	2	11	2	6½	2	5½	2	4
Slate	..	½	..	½	..	1	..	½
Coal	1	9½	1	11	1	11	1	7
Slate	..	½	..	1	..	1	..	½
Coal	..	3½	..	3½	..	4½	..	4½
Slate	..	½	..	1	..	½	..	½
Coal	3	11	4	2	3	11	4	4

A. Slope mouth coal outcrop; B. No. 8 butt right; C. No. 2 flat left; D. face of slope.

Rosemary mine. The Penn-Pitt Coal and Coke Company mines the Pittsburgh coal 1¼ miles above Greensboro from a drift in the steep bluff 150 feet above the river. This mine was opened in 1917, on a 250 acre holding. Mining is done by 5 shortwall machines and haulage by two trolley pole type locomotives and by mules. Electric power is purchased, 250 volts d.c. About 150 men are employed and the daily capacity of the mine is 1,800 tons. Shipment is all run-of-mine and by river barge. It operated on 31 days in 1930 and produced 14,292 tons.

The following sections were measured by E. E. Girod, mine inspector.

Sections of Pittsburgh coal in Rosemary mine.

	A		*B*		*C*		*D*	
	Ft.	*in.*	*Ft.*	*in.*	*Ft.*	*in.*	*Ft.*	*in.*
Sandstone	20	...	..	...	..	...	..	..
Coal	1	2	..	...	..	...	..	..
Slate	1	...	..	...	..	...	..	..
Coal	..	11	..	...	..	...	..	..
Draw slate	1	5	..	...	..	...	..	..
Coal	1	10	2	5	3	11½	3	4
Bone or slate	..	½	..	3	..	¾	..	¾
Coal	1	8	1	10	..	4	..	4
Slate	..	½	..	½	..	½	..	½
Coal	..	4	..	4	..	7	1	5
Slate or bone	..	1½	..	½	..	½	..	1½
Coal	3	9	3	5	3	1	2	3

A. Drift mouth. B. No. 4 right butt. C. Main dip left. D. Off main entry.

Sandy Run No. 1 mine. This mine of the Fredericktown Coal and Coke Company was on a 7-acre tract ¾ mile north of Greensboro. It was operated by a drift 80 feet above the river. All mining was by hand. It was exhausted about 1918. The bed at the mouth of the mine exhibits practically the same divisions and thickness as at the mouth of the Warwick mine.

The Department of Mines reports 186,483 tons mined by 118 men in 197 days in 1930. Perhaps this is a new mine of the same name.

Gabler No. 1 mine. This mine of the Vulcan Coal Company of Masontown, is ½ mile northwest of Greensboro and 120 feet above the river. It was a 7-acre tract, one-half of which was mined out in 1921, since which year it has been idle. The main bed under the draw slate is 8 feet 9 inches thick, including four thin partings totaling 3½ inches.

Rose mine. Near the Rosemary is the Rose mine of the Seventh Pool Coal & Coke Company. It is 117 feet above water, a drift mine in which two shortwall machines are used, and one storage battery locomotive. Electric power is purchased. About 40 men are employed and the output is several hundred tons daily. The company has 58 acres, only a few of which are mined out.

In 1930 this mine was operated by the Greensboro Gas Coal Co. and produced 7,520 tons in 45 days.

Measurements reported by E. E. Girod, mine inspector, are as follows:

Sections of Pittsburgh coal in Rose mine.

	A		*B*		*C*		*D*	
	Ft.	*in.*	*Ft.*	*in.*	*Ft.*	*in.*	*Ft.*	*in.*
Coal	3	10	3	8½	2	½	1	2
Slate	..	¼	..	...	..	1½	..	½
Coal	..	5	..	...	1	6	..	3
Slate	..	¼	..	...	..	½	..	½
Coal	1	7	..	...	..	2	2	1
Slate	..	¼	..	1	..	¾	..	¼
Coal	..	8	..	4	..	4	..	4
Slate	..	¼	..	¼	..	¾	..	¾
Coal	1	5	3	6½	3	8	3	6½

A. Drift mouth. B. No. 5 right section. C. No. 5 left section. D. Face of slope. April 5, 1922.

These sections show considerable variation in the way the bed is split. Over this bed are the following divisions in the roof in inches: Draw slate 11, coal 6, slate 14, coal 18, slate 26, coal 10, slate 10, coal 26, gray shale 15, sandstone. From this it is seen that 5 feet of coal in four benches is left in the roof.

The floor is hard clay.

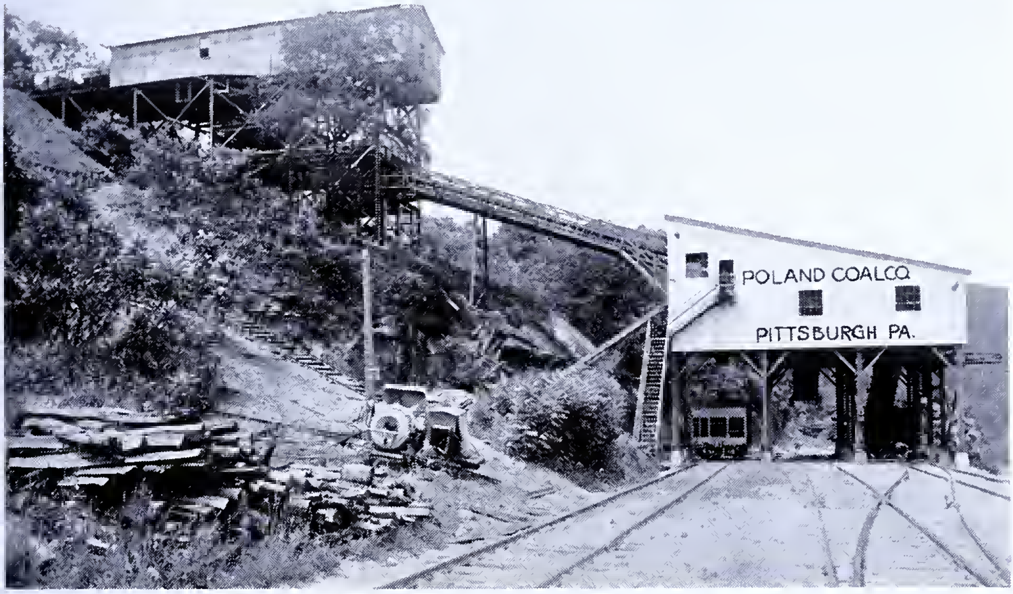

Fig. 24. Poland No. 3 mine, showing railroad and barge tipples.

Poland Nos. 1, 2, and 3 mines. The Monongahela Railway extension past the mouth of Dunkard Creek to the West Virginia line was put in operation in November 1914, and No. 1 mine of the Poland Coal Company was opened by a drift 72 feet above Dunkard Creek. The coal was mined by 11 chain breast and 1 shortwall machine and hauled by trolley pole type electric locomotives until 200 acres was mined out. No. 2 mine close by but 113 feet above the creek mined out 137 acres, leaving a few acres of coal in pillars. Both of these mines have been worked out and idle for several years.

In these two mines the upper bench ranged from 38 to 53 inches, the bearing-in bench from 3 to 8 inches, and the lower bench from 33 to 44 inches. There is no rider coal and several inches of the top bench were left to support the roof. Rock intrusions or rolls that nearly or quite cut out the coal are numerous.

Poland No. 3 mine was opened in 1917. It is a drift mine operated in the same manner as its predecessors. The number of men employed decreased from 144 in 1923 to 43 in 1925, but 60 men working 143 days in 1930 produced 93,861 tons.

The Poland No. 3 mine is on the west bank of Monongahela River ½ mile north of Poland station. It is 90 feet above the river and delivers coal by chute down the steep bluff to a spur track. The output in 1923 was about 1,000 tons daily. Coal is screened with 1¼ inch bar screens and picked on car.

In this mine the coal bed is split by several bony binders which are very hard to separate. The miners have to use more explosive than normal and this increases the percentage of slack. A small fault which drops the coal 4 feet, cuts Nos. 9 and 10 right flat entries at right angles, and at the face of No. 7 left flat solid rock has been encountered, leaving but a few inches of coal.

The roof is 4 feet of shale over draw slate. In places, however, the immediate roof is sandstone. This mine was sampled at five points by L. D. Woodworth on February 23, 1922.

Sections of coal bed in Poland No. 3 mine.

Section	A		B		C		D		E	
Laboratory No.	84428		84429		84430		84431		84432	
	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.
Roof coal*	1	0	1	0		9				
Bony coal*		½		1		1		6		9
Coal		4	1	11		9		3		3
Bony coal*		½		½				½		1
Shale						¼				
Coal	1	0	1	10	1	3		6	1	11
Sulphur								¼		
Bony coal*		½		1						2
Shale*						½				
Coal		7	2	1	1	10	1	4	1	4
Bony coal*						1		½		
Sulphur*										½
Shale*		½								
Coal		5						4		1
Bony coal*		½						½		½
Coal	1	7					1	4		4
Bony coal*		1						1		½
Coal	2	2			2	2	1	10	1	6
Thickness of bed	7	4½	7	½	6	10¾	6	3¾	6	6½
Thickness of sample	6	1	5	10	5	11¼	5	7¼	5	5

*Not included in sample.

Mabel No. 1 mine. The Mabel Coal Works of Point Marion has three mines on the north side of Dunkard Creek near its mouth, one on the Pittsburgh and two on the Sewickley coal. Mine No. 1 on the Pittsburgh coal is 176 feet above Monongahela River. It was opened when the Monongahela Railway was extended to the mouth of Dunkard Creek and was operated by hand labor. An output of 200 tons daily was made and the 17 acres in this property were mined out about 1924. In places the 3-inch draw slate is absent and sandstone rests on the coal. The thickness of the main bed ranged from 6 to 9 feet. Where thickest it contained a single 20-inch slate band 33 inches from the floor.

Shannopin mine. At the bend of Dunkard Creek two miles due west of its mouth a mine was opened by the Shannopin Coal Company in the spring of 1924. It is in the west bank 15 feet above the creek. According to E. E. Girod, mine inspector, the main entry was driven about 50 feet and two parallel entries just broke into the coal, a bridge was built across the creek and then development ceased. He measured at the entry the section on the next page.

The thickness of the bed is said to be variable, owing to a distorted condition of the strata.

In 1926 Jones & Laughlin Steel Co. of Pittsburgh began further development of this property and in 1928 a railroad and concrete highway had been built from the river to the mine, Bobtown a village of 354 houses, with schoolhouses, church, stores, theater, and offices had been built, and two mines were delivering coal to a tipple on the bank

Section of Pittsburgh coal at Shannopin mine.

	Ft.	in.
Sandstone	30	
Slate	5	8
Coal	1	8
Draw slate		10½
Coal	1	1
Bone coal	1	
Coal	2	9
Slate		½
Coal	1	4½
Slate		¼
Coal		4
Slate		¼
Coal	2	1
Fire clay		

of Monongahela River just below the mouth of Dunkard Creek. In 1928, Bobtown, had a population of 1200, of whom 400 were employed by the coal company. In 1930 the output by 317 men was 570, 834 tons in 269 days. Poland is a new settlement at the mouth of Dunkard Creek.

Dunkard No. 2 mine. The first mine on the Pittsburgh coal encountered south of Dunkard Creek is the Dunkard No. 2 of the Mapel-Sterling Coal Company of Dunkard. It is a drift mine in the steep bank 200 feet above Monongahela River. Two shortwall machines are used for mining and gasoline locomotives for haulage. Power is purchased, 220 volts a.c.; 1-200 kw. m.g. set, 500 volts d.c.

L. D. Woodworth who visited this mine in 1922 writes of it: "In the vicinity of Point Marion the roof division of the Pittsburgh coal bed seems to consist of shale only, and this shale is frequently cut out by the sandstone cap rock, making the sandstone the immediate roof. This is the case in Dunkard No. 2.

"The coal in Dunkard No. 2 is pretty well streaked with bone and shale, but this mine is well equipped with a conveyor and belt picking table, so that the coal is usually pretty clean by the time it reaches the railroad car."

A persistent impurity in the bed is 7 to 10 inches of bony coal 1 foot below the roof. A large roll in the main heading cuts out all but 2 feet of the coal for nearly 100 feet.

The capacity of the mine is 700 tons daily, shipped as run-of-mine, slack, nut, lump, and gas. The tract includes 175 acres.

The following sections were measured by L. D. Woodworth on March 1, 1922:

Sections of coal bed in Dunkard No. 2 mine.

Section	A		B		C		D	
Laboratory No.	84524		84525		84526		84527	
	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.
Coal	1	3	1	1		10	1	0
Bony coal*		7		10		9	1	0
Coal	1	8	1	7	1	5	1	3
Bony coal*		½		1		½		½
Coal		3		4		5		4
Bony coal*		½						1
Shale*				½		1		
Coal	1	4		4	1	7	2	0
Bony coal*		½				1		½
Sulphur*				½				
Coal	1	4	1	5	1	9	1	5
Shale*				½				
Sulphur						¼		
Coal			1	4		10		
Thickness of bed	6	6½	7	1½	7	9¾	7	2
Thickness of sample	5	10	6	1	6	10¼	6	0

* Not included in sample.

Moffitt mine. The Moffitt mine of the Moffiitt-Sterling Gas Coal Company is half a mile south of the mouth of Dunkard Creek and 244 feet above the river. It is a drift mine using shortwall machines, mules, and one 6-ton locomotive. Power purchased is 220 volts a.c.; the equipment is m.g. sets and rotary converters, 220 volts d.c. About 150 men are employed, and the daily capacity is 2,000 tons. Bar and shaker screens, and picking tables are used and the coal is shipped as run-of-mine, lump, and nut.

The cap rock is sandstone, separated from the coal by 8 to 10 inches of draw slate. Six to 8 inches of coal is left under the draw slate. Some hard sandstone rolls in places completely cut out the coal. The floor is hard clay.

Mining began here in 1922 on a tract of 520 acres. In 1930 the yield was 165,850 tons by 155 men in 260 days.

E. E. Girod, mine inspector, reports the following measurements May 16, 1922:

Sections of Pittsburgh coal in Moffitt mine.

	A		B		C		D	
	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.
Coal		10	--	--	1	3	1	11
Bone		6	--	--		8		8
Coal	1	$9\frac{1}{2}$	4	5	1	$8\frac{1}{2}$	1	9
Slate		$\frac{3}{4}$		$\frac{1}{2}$		$\frac{3}{4}$		$\frac{3}{4}$
Coal		4		$4\frac{1}{2}$		4		4
Slate		$\frac{3}{4}$		$\frac{1}{4}$		$\frac{3}{4}$		1
Coal	4	1	3	9	3	8		10
Slate	--	--	--	--	--	--		1
Coal	--	--	--	--	--	--	2	10
Thickness of bed	7	8	8	7	7	9	8	7

A. Drift mouth. B. Barrier heading. C. Face of No. 1 butt left. D. Off main entry.

The persistence of the 4-inch bench in all the mines in the vicinity is notable.

In sections B and D the thickness of the bed is the same, 8 feet 7 inches, but section D has 10 inches more of slate and bone.

Walnut Hill mine. The West Point Marion Coal Company of Dilliner opened a mine several years ago on the west bank and 343 feet above Monongahela River opposite Point Marion. It is a drift mine with 2 shortwall machines for mining. Haulage is by mules and gasoline locomotives. Power is purchased. Transformer 6600-200 volts a.c. About 100 men are employed and the output in 1930 was 163,000 tons. The coal is prepared on gravity screens and shipped as run-of-mine, slack, nut, and lump.

Six inches of the upper bench of the coal is left up for roof to save handling the draw slate. An 11-inch rider coal is then lost in the roof. The average thickness of the bed is 86 inches but it contains 5 or 6 binders of slate and bone coal ranging from ½ to 7 inches thick. The tract of 115 acres is nearly mined out.

Jeanette mine. In a hilltop 340 feet above the river and half a mile southwest of Point Marion is the Jeanette mine of the Greene County Coal and Coke Company of Point Marion, opened in 1917. It is a drift mine with less than 75 feet of cover. One shortwall machine is used for mining and trolley pole locomotives for haulage. Power purchased is 220 volts a.c.; 1-100 kw. 250 volts d.c. The coal passes bar screens and is shipped on the Monongahela Railway as run-of-mine, slack, nut, and lump. The daily capacity is about 800 tons. In 1930 this mine employed about 37 men and produced 22,673 tons in 124 days.

Unless more acreage has been added to the original 34 the mine must be nearly exhausted.

At several places in the mine the draw slate and rider coal are cut out and the overlying sandstone rests directly on the main bed.

The coal in this mine was measured and sampled by L. D. Woodworth on February 28, 1922.

Sections of coal bed in Jeannette mine.

Section	A		B		C	
Laboratory No.	84475		84476		84477	
	Ft.	in.	Ft.	in.	Ft.	in.
Coal*		6				
Coal and clay*				7		
Bony coal*		6			1	2
Coal		3		10		3
Bony coal*		1		4		1
Coal		11		3	1	2
Bony coal*		½		½		½
Coal		5	1	0		4
Shale*		½		1		½
Coal		7	1	8		11
Bony coal or shale*		½		1		½
Coal		7	1	10		2
Sulphur		¼				½
Coal		3				3
Bony coal*		2				2
Coal	2	3			2	5
Thickness of bed	6	7¾	6	8½	7	1
Thickness of sample	5	3¼	5	7	5	6

* Not included in sample.

REDSTONE COAL.

The Redstone coal is 35 to 70 feet above the Pittsburgh coal and outcrops along Monongahela River from the State line to the mouth of Whiteley Creek. Its horizon is above water level on Tenmile Creek from Clarksville to Millsboro but here it seems to be composed of less than a foot of coal and carbonaceous shale.

In Monongahela Township Woodworth reports 3 feet of coal 35 feet above the Pittsburgh bed at Alicia Mine No. 2. Fettke found a greater interval. Woodworth and Fettke[1] give the following measurements.

Sections near Alicia No. 2 mine.

	Woodworth	Fettke	
	Ft.	Ft.	in.
Sewickley coal	5	5	4
Shale	5	8	5
Limestone	3	5	2
Shale	3	4	4
Coal	½		5
Limestone	5	6	4
Shale	20	30	6
Coal (Redstone)	3	2	10
Limestone	30	13	
Shale	5	30	
Coal (Pittsburgh)			

The distance between the Sewickley and Pittsburgh coals is 74 feet where measured by Woodworth and 101 feet where measured by Fettke.

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[1] Fettke, Chas. R., Oil resources in coals and carbonaceous shales of Pennsylvania: Pennsylvania Geol. Survey, 4th series, p. 66, 1923.

Sections of Redstone coal at Alicia No. 2 mine.

	Inches		Inches
Carbonaceous shale	----------		
Coal	1	Bone	----------
Carbonaceous shale	½	Carbonaceous shale	----------
Coal	11	Bony coal	2
Carbonaceous shale	¼	Bone	¼
Coal	8	Coal	8
Carbonaceous shale	¼	Clay parting	¼
Coal	13	Coal	25
	34		35½

The first section was measured by Fettke and the second by Stone at different times and places. Whether they represent actual variations in the bed or merely differences in judgment has not been determined.

The Redstone horizon is exposed at an elevation of 960 feet in the Mapletown road half a mile northwest from Greensboro. Here Fettke found it 40 feet above the Pittsburgh coal with the following section:

Section of Redstone bed near Greensboro.

	Ft.	in.
Gray shale	----	----
Fissile carbonaceous shale	3	6
Bituminous coal	1	6
Cannel shale	4	6
Gray shale	----	----

The shales just above and below the Redstone coal at Greensboro were called cannel coal by the people in the vicinity when I. C. White measured a section here in 1875. In his field notes is this statement: "It is however only a very bituminous shale. A company was once organized to distil oil from it, but before they were ready to commence operations, petroleum was discovered in such large quantities in this country that the enterprise was abandoned. These shales contain in some localities a quantity of black band iron ore, but it does not seem to be persistent enough to warrant mining."

In Dunkard Township the Redstone horizon is represented only by carbonaceous shale. Along the eastern boundary of the county, therefore, the Redstone coal is too thin to be of present value, in view of its close proximity to the thick Pittsburgh bed. It underlies all of the county except a small area along the river in Dunkard Township.

SEWICKLEY (MAPLETOWN) COAL.

A bed of coal generally known throughout western Pennsylvania as the Sewickley outcrops in the extreme eastern part of the county. It has been mined extensively at Mapletown and for that reason is known locally as the Mapletown coal.

The horizon of the Sewickley coal is from 74 to 130 feet above the Pittsburgh coal along Monongahela River, and in Springhill Township at the other side of the county the interval is practically the same. In this township, according to well records, the distance between the Sewickley and Pittsburgh coals ranges only between 79 and 119 feet, and 45 of 74 records averaged an interval of exactly 100 feet. In these well records the thickness of the coal is variously reported from 3 to 10 feet.

The outcrop of the Sewickley coal in Greene County is limited to the valley of Tenmile Creek below Jefferson, to the valley of Monongahela River above Little Whiteley Creek, and to Dunkard Creek below Meadow Run.

Below Grays Landing the Sewickley coal is widely split by thick partings or is thin and composed largely of bituminous shale.

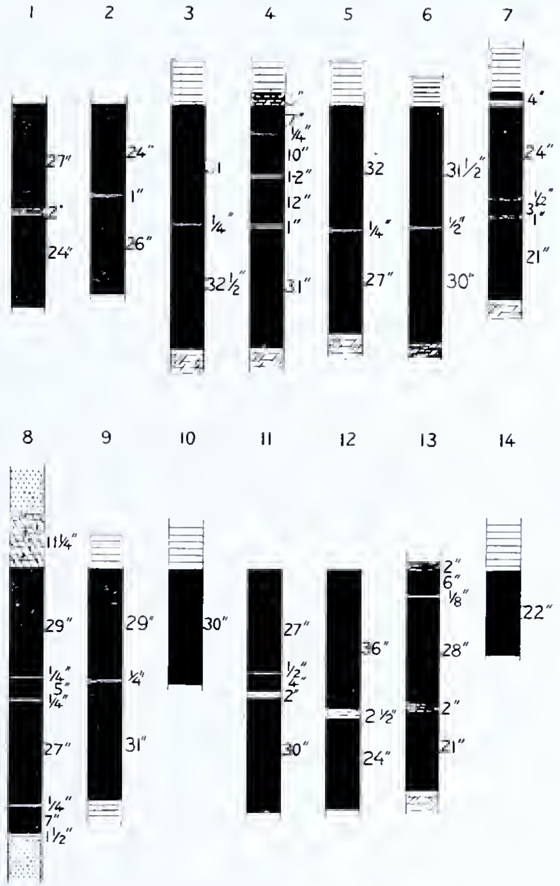

Fig. 25. Sections of Sewickley (Mapletown) coal bed.

1. Mapel-Sterling Coal Co., Dunkard No. 1 mine, mouth of Dunkard Creek.
2. Dunkard Creek, mouth of Meadow Run.
3. Greensboro Coal Co., Black mine, 1¼ mile S. W. of Greensboro.
4. Mabel Coal Works, Mabel No. 2 mine, 2¼ miles S. W. of Greensboro.
5. Frederickstown Coal & Coke Co., Sandy Run No. 2 mine, ¾ mile N. W. of Greensboro.
6. Penn-Pit Coal & Coke Co., Dora mine, 1 mile S. W. of Greensboro.
7. Rosedale Coal Co., Rosedale No. 2 mine, ½ mile N. W. of Poland.
8. Seventh Pool Coal & Coke Co., Marie mine, 1½ miles S. W. of Greensboro.
9. McGrew & Gapin, Titus mine, 1¼ miles W. of Poland.
10. Mouth of Big Whiteley Creek.
11. Mapletown.
12. Grays Landing.
13. Pittsburgh Steel Co. mine ½ mile S. of Grays Landing.
14. Tenmile Creek near Clarksville.

The first mine in the Sewickley coal that is met by one ascending the river is that at the Alicia No. 2 mine of the Monessen Coal and Coke Company half a mile south of Grays Landing. This mine in the

Sewickley coal is above the boiler house and near the original Alicia No. 2 slope at the tipple. It is about 100 feet above the river and is worked to supply fuel for the boilers of Alicia No. 2. Mining is by hand labor and the output is 40 tons per day. The company has 600 acres of this coal. Measurements of the bed were made by L. D. Woodworth on February 14, 1922.

Sections of Sewickley coal bed from near Alicia No. 2 mine.

Section	A		B	
Laboratory No.	84246		84247	
	Ft.	in.	Ft.	in.
Bony coal*		2		2
Coal		6		5
Slate	*	½		⅛
Coal	2	0	2	4
Bony coal*		3		2
Slate		½	----	----
Coal	1	9	1	9
Slate*		1	----	----
Coal		2	----	----
Thickness of bed	5	0	4	11½
Thickness of sample	4	3	4	7⅛

* Not included in sample.

Sandy Run No. 2 mine. The second mine on the Sewickley coal is that of the Fredericktown Coal and Coke Company at Sandy Run opposite Martin. This is a drift mine 170 feet above the river and 3,000 feet inland on a 200-acre tract. Mining began about 1921 and the mine has a daily capacity of about 1,800 tons. One hundred and forty five men are employed. The coal is cut by four shortwall machines and hauled by mules and by trolley pole type locomotives. It goes over picking tables and is all shipped as run-of-mine. A 42-inch belt conveyor 380 feet long delivers coal for river shipment to a tipple on the Greene County shore and that for railroad shipment is carried over the river to Martin by an aerial tram. Steel towers 90 feet high support a cable span 800 feet long with a clearance of 75 feet above full-pool stage in the river. The tram carries 22 buckets of 50 cubic feet capacity. These ordinarily carry 1 ton of coal each and the tram delivers 200 tons per hour. This tram was built in 1925 and is the only one of its kind in Greene County. According to E. E. Girod, mine inspector, the roof is hard shale, floor is bone, and the coal is in two benches separated by a ¼-inch binder near the middle of the bed. The top bench is 29 to 38 inches thick and the bottom one is 26 to 31 inches, making a bed that averages 62 inches.

In 1930 this mine employed 118 men, operated 197 days, and yielded 186,483 tons.

Gabler No. 2 mine. Close by the Sandy Run mine is the Gabler No. 2 of the Vulcan Coal Company of Masontown. Operation began in 1923 on a 70-acre tract and the output was about 200 tons per day by hand labor. A ¼ to ½ inch slate binder near the middle of the bed is persistent and the only impurity in a bed that averages 5 feet 2 inches thick. This mine was acquired by the Fredericktown Coal and Coke Company in 1925 and is now part of the Sandy Run No. 2 mine.

Black mine. Just west of Greensboro Sam Black has been mining the Sewickley, Mapletown, or 5-foot bed, but was idle in 1925. This is a drift mine 247 feet above the river on a 21-acre tract, of which 3 or 4 acres have been mined out. One slate binder ¼ inch thick is persistent, with 32 to 36 inches of coal in the lower bench and 28 to 36 inches in the upper bench. The capacity of the mine with hand labor is about 100 tons a day. Delivery is by truck to local trade, many people preferring the Mapletown to the Pittsburgh coal for domestic use. This mine has been idle several years.

Marie mine. One and one-half miles southwest of Greensboro is the Marie mine of the Seventh Pool Coal and Coke Company 197 feet above the river. It is a drift mine operated by the shortwall method, mining with machines. The coal bed runs from 61 to 70 inches thick, including one to three slate binders, each ¼ inch thick. The capacity of the mine is 100 tons per day from a tract of 32 acres. This mine, now owned by the Penn-Pitt Coal & Coke Co. is idle.

Dora mine. The Dora mine is 1¼ miles southwest of Greensboro 162 feet above Monongahela River in the steep bluff. It is a drift mine with a capacity of 400 tons daily and employs 50 men. Mining is by shortwall machines and haulage by mules. This mine was opened in 1922 on a 150-acre tract. It belongs to the Penn-Pitt Coal and Coke Company of Greensboro. As in the other mines already described, the Sewickley coal bed in the Dora mine has one slate binder one half inch thick very near the middle of a bed that averages 5 feet 2 inches thick. The roof is shale and the floor is bone. This mine produced 125,875 tons in 1930, with 31 men employed 120 days.

Mabel mines Nos. 2 and 3. The Mabel Coal Co. of Point Marion operates two mines on the Sewickley coal 2 miles southwest of Greensboro. Both are drift mines and served by the Monongahela Railway. No. 2 is 258 feet above the river and was started in 1921 on a 7½-acre tract. No. 3 is 242 feet above the river and was opened in 1922 on a 238-acre tract. Mining is by shortwall machines and haulage by mules and trolley pole locomotives. Electric power is purchased for m.g. sets 220 volts a.c. About 49 men were employed 143 days in 1930 and mined 37,720 tons from No. 3.

According to E. E. Girod, mine inspector, the average thickness of the coal bed in Mabel No. 2 is 5 feet 6 inches. At the top is 3 to 12 inches of bony coal, then 55 to 63 inches of coal with 2 or 3 binders, each ¼ inch thick, near the middle of the bed. In Mabel No. 3 the one measurement at the mouth shows 4 inches of bony coal at the top, an upper 24-inch bench, a 4-inch bearing-in bench, and a lower bench 31 inches thick. The bearing-in bench is separated from the others by two bone binders, each ½ inch thick.

Rosedale No. 2 mine. The Rosedale Coal Company of Morgantown, W. Va., mines the Sewickley coal where it is 235 feet above Monongahela River near Poland. Two shortwall machines are used for mining and two trolley pole type locomotives for hauling the coal. Shipments in 1923 were 120,000 tons, with 75 men employed. The company has about 900 acres of this coal. Shipments are as run-of-mine, slack, and lump, and made over the Monongahela Railway.

Well within the mine the bed is from 42 to 61 inches thick with two bone binders not over ½ inch thick occurring regularly about 3 inches apart near the middle of the bed. In some places a few inches of bony coal is found at the top of the bed.

For about 200 feet in from the drift mouth the thickness of the coal ranges from 1½ to 3½ feet. Farther back in the mine conditions are normal and the coal is 4½ to 5 feet thick. This unusual condition at the drift mouth is believed by some mine operators to have some relation to the large "fault" that cuts out the coal in the Poland mines 80 feet directly below in the Pittsburgh bed.

The Rosedale mine was sampled at three points by L. D. Woodworth on February 25, 1922.

Sections of Sewickley coal bed in Rosedale No. 2 mine.

Section	A		B		C	
Laboratory No.	84479		84480		84481	
	Ft.	in.	Ft.	in.	Ft.	in.
Coal and shale*		5				4
Bony coal*				4		
Coal		5	1	9½	2	0
Shale		⅛				
Bony coal*				½		½
Coal				3		3
Bony coal*				½		1
Coal	3	10	2	2	1	9
Coal and shale*				5		
Thickness of bed	4	8⅛	5	½	4	5½
Thickness of sample	4	3⅛	4	2½	4	0

* Not included in sample.

Dunkard No. 1 mine. The Mapel-Sterling Coal Company of Dunkard mines the Sewickley (Mapletown) coal in the hill directly above its No. 2 mine in the Pittsburgh bed in the west bank of Monongahela River just below the mouth of Dunkard Creek. The original small acreage was mined out in February 1921 and the mine was idle until an adjoining tract of 200 acres was acquired early in 1922.

The floor of the mine is hard fire clay which has numerous rolls up to 18 inches in height, that interrupt the continuity of the bed. The average thickness of the bed is about 4 feet 8 inches. The coal is mined by 2 shortwall machines and hauled by gasoline locomotives. It passes over bar screens and picking tables and is shipped via Monongahela Railway as run-of-mine, slack, nut, and lump. The daily capacity is 400 tons. Electric power purchased is 220 volts a.c. to operate one 200 kw. m.g. set, 500 volts d.c. Shipments in 1930 were only 8,548 tons, with 29 men employed 53 days.

This mine was sampled at two points on March 1, 1922 by L. D. Woodworth.

Sections of Sewickley coal bed in Dunkard No. 1 mine.

Section	A		B	
Laboratory No.	84521		84522	
	Ft.	in.	Ft.	in.
Coal	2	8	2	3
Shale and coal*		2		
Bony coal*				2
Coal	1	10	2	0
Shale*		½		
Coal*		3		
Thickness of bed	4	11½	4	5
Thickness of sample	4	6	4	3

* Not included in sample.

Titus mine. A truck mine on Dunkard Creek 2 miles below Dunkard village is operated by McGrew and Gapin. The mine is a small one with a capacity of about 100 tons per day by hand methods. The following measurements were made in this mine by E. E. Girod, mine inspector, on August 24, 1922.

Sections of Sewickley coal bed in Titus mine.

	A		B		C		D	
	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.
Bone coal						4		
Coal	2	0½	3	0½	2	4	2	5
Slate		¼		¼		¼		¼
Coal	2	0	2	9½	2	5	2	6½

A. Mouth of drift. B. No. 3 main right. C. No. 1 butt left. D. Off main entry.

At the mouth of Meadow Run on Dunkard Creek where the Sewickley (Mapletown) coal is at water level the bed is 4 feet 3 inches thick, including a 1-inch clay parting in the middle. This is a little thinner than at Mapletown, where the total thickness of the bed is 5 feet 3½ inches, including 2½ inches of clay parting near the middle of the bed. This coal has not been mined at Mapletown for many years.

Keystone Coal Buyers Catalog for 1928 lists two other mines in the Sewickley coal. The Staggers mines of the Evans Coal Mining Co., near Dilliner with a daily capacity of 500 tons, and the Wylie mine of the Cumberland Fuel Co., below Nemacolin with a capacity of 300 tons.

On Tenmile Creek the Sewickley (Mapletown) bed is much thinner, measuring from 18 to 22 inches, and is not worked because the Waynesburg and Pittsburgh beds supply the demand.

The presence of the Sewickley coal throughout the county is recognized by the logs of many deep wells.

UNIONTOWN COAL.

A small coal seam known as the Uniontown lies about 275 feet above the Pittsburgh and 80 feet below the Waynesburg coal in the eastern part of the county and is supposed to be persistant over a considerable area. Although seen in a number of places on South Fork of Tenmile Creek and on Dunkard Creek, it cannot be asserted that this coal is widely distributed because the bed is deeply buried everywhere but on these two streams and along Monongahela River. It is so thin that it is recognized and recorded by drillers in only a few places. The small coal bloom seen occasionally in the road gives no clue to the details of the bed, but in places suggests about 8 inches of coal. Near Dunkard village the horizon is marked by black shale, and on Meadow Run below Davistown by a richly bituminous shale with cannel-like fracture. This shale contains many minute fish scales and teeth. A measurement of the bed was made 50 years ago on Pumpkin Run near Rices Landing. It is reported this bed was worked here on a limited scale and that it consisted of an upper bench 18 inches thick separated by 10 feet of flaggy sandstone from a 6-inch lower bench resting on ferruginous limestone. So thin a coal seam is not of commercial importance and one might wonder at its being mined on Pumpkin Run where the Waynesburg bed more than 5 feet thick is just above it. Above Rices Landing around the mouth of Muddy Run the Uniontown coal is 18 inches to 2 feet thick and 93 feet below the Waynesburg coal.

In Richhill Township a coal from 229 to 263 feet above the Pittsburgh and from 53 to 105 feet below the Waynesburg was recognized in several wells and thought to be the Uniontown. The thickness of the coal bed reported in these wells ranges from 2 to 4 feet, but may be exaggerated.

WAYNESBURG COAL.

The coal bed that marks the top of the Monongahela group or Upper Productive Coal Measures extends from McDonald, Washington County, well down into West Virginia. In northern Washington County and in Allegheny County, however, it is thin and rarely of any value. In West Virginia it has been traced to where it is barely 6 inches thick. This bed is thickest in southeastern Washington County, throughout Greene County, and the adjoining portion of West Virginia. It underlies practically all of Greene County except the corner east of Davistown and Mapletown, and takes its name from the county seat.

The total thickness of the bed in many places is 6 feet or more, but it is so broken by clay partings and the coal itself is often so impure that mining is expensive. Also the roof in many places is a soft shale that requires much timbering and the floor is a soft mucky clay into which the posts sink. In spite of these drawbacks the Waynesburg coal has been mined probably for 75 years or more in this county. This is because the Waynesburg coal is the one most accessible to the larger part of the county. The Sewickley coal, because of its regularity, better roof, and its freedom from thick partings, is a better mining proposition but its outcrop is much more restricted, and in the days of teaming, people would use a poorer coal mined near at hand rather than drive many miles to get a coal with less ash and sulphur.

The Waynesburg bed yields a hard block coal which has little or no coking value. Some part of the bed is likely to be worthless from the high percentage of ash and sulphur. The average composition of the bed is about 50 per cent fixed carbon, from 32 to 36 per cent volatile matter, 1.3 to 3 per cent sulphur, and 11 to 13.5 per cent ash.

The outcrop of the Waynesburg coal bed extends up the South Fork of Tenmile Creek to Dodysburg, a village 1 mile east of Waynesburg, up Muddy Run to Carmichaels, and up Little Whiteley Creek to Ceylon, and of course is exposed in the short ravines entering Monongahela River below Little Whiteley. From Hatfield ferry the outcrop follows a very irregular course across the hills to Mount Morris and the West Virginia line. The only other outcrop in the county is on Enlow and Dunkard forks of Wheeling Creek.

In the greater part of the county the Waynesburg coal lies far below the surface. The depth is calculated to be about 270 feet at Ruff Creek. 200 feet at Sycamore, 250 at Oak Forest and Spraggs, 400 at New Freeport, 350 at Rogersville, 500 at Nineveh, and 400 at Graysville.

This coal bed has been opened at many places and in some has been mined rather extensively for a country or wagon bank. Many of these mines that were working at the time of the Second Geological Survey in 1875 had long been abandoned and were inaccessible when the United States Geological Survey made a detailed examination of Greene County in 1900-1904. Some of the mines that were producing then were still in operation when the writer revisited the county in 1925, others were almost forgotten, and new ones were being opened.

Rices Landing. A mine on the Waynesburg coal formerly belonging to Dr. S. A. Hoge, has been operated in the winters since 1922 by A. W. Behling who lives on the property and has a tipple beside the main road leading from Dry Tavern down the ravine to Rices Landing.

The mine is up hill back from the road. It is a custom bank supplying purely local demand. According to L. D. Woodworth the bed is 5½ feet thick.

Section of Waynesburg coal bed in Hoge mine.

Laboratory No.	84052	
	Ft.	in.
Coal		5
Sulphur*		½
Coal	1	0
Clay*	1	4
Coal	1	10
Slaty coal*		2
Coal		10
Thickness of bed	5	7½
Thickness of sample	4	1

* Not included in sample.

The roof is shale and the floor is clay. A 16-inch band of clay above the middle of the bed requires much labor to remove. All mining is by hand pick.

Waynesburg coal mines in this ravine belonging to Anderson Moredock and J. A. Faddis are close beside the road but idle.

Less than 2 miles from Rices Landing in the bank of Pumpkin Run on the Price farms the Waynesburg coal is mined every winter by W. L. Price. A tipple above the mine mouth on the direct highway from Jefferson to Carmichaels makes delivery to customers easy. Under the Waynesburg sandstone, which outcrops conspicuously along the road here, is 10 feet of shale and 6 inches of coal which is not taken down. According to Mr. Price the main bed is in three parts, a top coal 2 feet thick which is cut out by the draw slate in places, a slate parting that ranges from 1 to 18 inches thick, and a regular bottom bench 3 feet thick.

Near Arensburg Ferry two miles below the mouth of Muddy Run, and one mile south of the ferry, openings showed the following sections:

Waynesburg coal near Arensburg Ferry.

	Arensburg Ferry		1 mile south	
	Ft.	in.	Ft.	in.
Coal	0	6	0	5
Clay	0	½	0	1
Coal	1	10	2	0
Clay	0	6	0	2-60
Coal	2	9	3	0
	5	7½	5 ft. 10 ft.	8″ to 6 in.

At the latter place the lower clay parting is 2 inches thick at the mouth of the entry but swells to 5 feet within 100 feet inside the mine.

At another opening one mile below the mouth of Muddy Run the upper bench of the Waynesburg coal measures 9 inches, the middle bench 2 feet, and the lower bench 2 feet 6 inches.

Formerly the Waynesburg coal was open at several places between Carmichaels and Monongahela River along Muddy Run but most of these are closed now. At a mine on the east side of the run, about a mile from the river, the coal is in three benches, from the top down 11, 25, and 30 inches thick. The clay parting between the middle and lower benches varies from 7 to 18 inches. At the mouth of Muddy Run the coal is in three benches, 8, 18, and 28 inches thick.

Carmichaels. Just below the cemetery at Carmichaels Muddy Creek has cut a ravine in the Waynesburg sandstone and falls about 11 feet over the bottom ledge. The Waynesburg coal is exposed by the falls and from there down stream has been mined in 8 or 10 places. Jacob Hathaway was mining this coal under the high sandstone cliff in the fall of 1925. The drift mouths are at or just above creek level and high water both enters the drifts and carries away the waste. There is abundance of this from the three thin and one thick partings and from the shale roof. One parting is about 3 feet thick and is removed only with much labor. The roof shale is exceptionally interesting for it contains an abundance of well preserved plant fragments. The coal bed is over 9 feet thick but includes 4 feet or more of clay bands or partings.

Waynesburg coal on Muddy Run north of Carmichaels.

	Ft.	in.
Coal	1	0
Clay	0	2
Coal	1	9
Clay	0	2-10
Coal	2	2
Clay	3	0
Coal	0	3
Clay	0	4
Coal	0	5
	9	7

On the David Sanner land three-quarters of a mile northeast of Carmichaels this coal has been opened by three drifts side by side. The middle drift is being mined by one man for local trade.

About the same distance east of Carmichaels Mr. J. Guseman was mining this coal on the east side of Glade Run 50 years ago. Today Albert Guseman continues the business. The mouth of the Guseman drift is in the road forks, and 6 acres have been mined out, leaving 42 acres in reserve. It is a one-man operation, producing about 5 tons per day.

E. E. Girod, mine inspector, furnished these sections:

Sections of Waynesburg coal at Guseman mine.

	A		B		C		D	
	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.
Coal	1	11	2	0	2	1	1	9
Slate		2		1¼		9	1	2
Coal	2	3	2	8	2	10	2	5

A. First inby from drift mouth. B. First right. C. First left. D. Off main entry.

Above this main part of the bed there is a bone coal irregular in thickness but commonly about 2 inches, and 10 inches of poor coal directly under the sandstone roof.

On the Marshall Collins farm where the road to Nemacolin crosses Glade Run, a quarry in the Waynesburg sandstone has uncovered the coal in the floor and broken into an old mine. As the quarry floor is cleaned the coal is stripped and used for raising steam to drive drills and crusher. The bed is irregular but runs up to 6 feet thick with 4 inches of clay in the middle, and includes 8 to 10 inches of poor coal just under the sandstone.

Sections at former openings about due east of Carmichaels were measured as follows:

Waynesburg coal 1 mile east of Carmichaels.

	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.
Coal	0	10	0	11	0	10	0	10
Clay	0	2	0	3	0	2	0	3
Coal	1	6	2	4	1	9	2	2
Coal	1	6	2	4	1	9	2	2
Clay	2	0	0	6	3	0	0	4
Coal	2	8	2	8	3	0	3	0
	7	2	6	8	8	9	6	7

At Parkers Bar on Monongahela River 1½ miles below the mouth of Little Whiteley Creek and at an opening ½ mile below the mouth of this creek this bed has the following character:

Waynesburg coal near Parkers Bar.

	Parkers Bar		1 mile south	
	Ft.	in.	Ft.	in.
Coal	1	2	1	0
Clay	0	2	0	2
Coal	2	0	2	1
Clay	1	0	1	1
Coal	2	6	3	0
	6	10	7	4

About 4 miles south of Carmichaels on the South Fork of Little Whiteley Creek traversed by the road to Mapletown, the Waynesburg coal has been mined more or less continuously by a succession of small mines on a small run entering Little Whiteley Creek below Paisley. When one became too difficult to keep open, a new mine was started. The latest was opened in 1924 on the J. Lesley Hartley place by W. H. Mapel. After a year it consisted of a 200-foot drift and four rooms. Under several feet of shale is a variable coal bed, the top coal being 1 to 2 feet thick, the shale parting from 1 to 30 inches thick, and the bottom coal 2½ to 3 feet.

A section in one of these old mines shows many partings:

Waynesburg coal south of Paisley.

	Ft.	in.
Shale		
Coal	0	2½
Bone	0	½
Coal	0	2½
Bone	0	¼
Coal	0	3½
Shale	0	1½
Coal	2	0
Shale	0	11
Coal, seen	2	0+
	5	9¾+

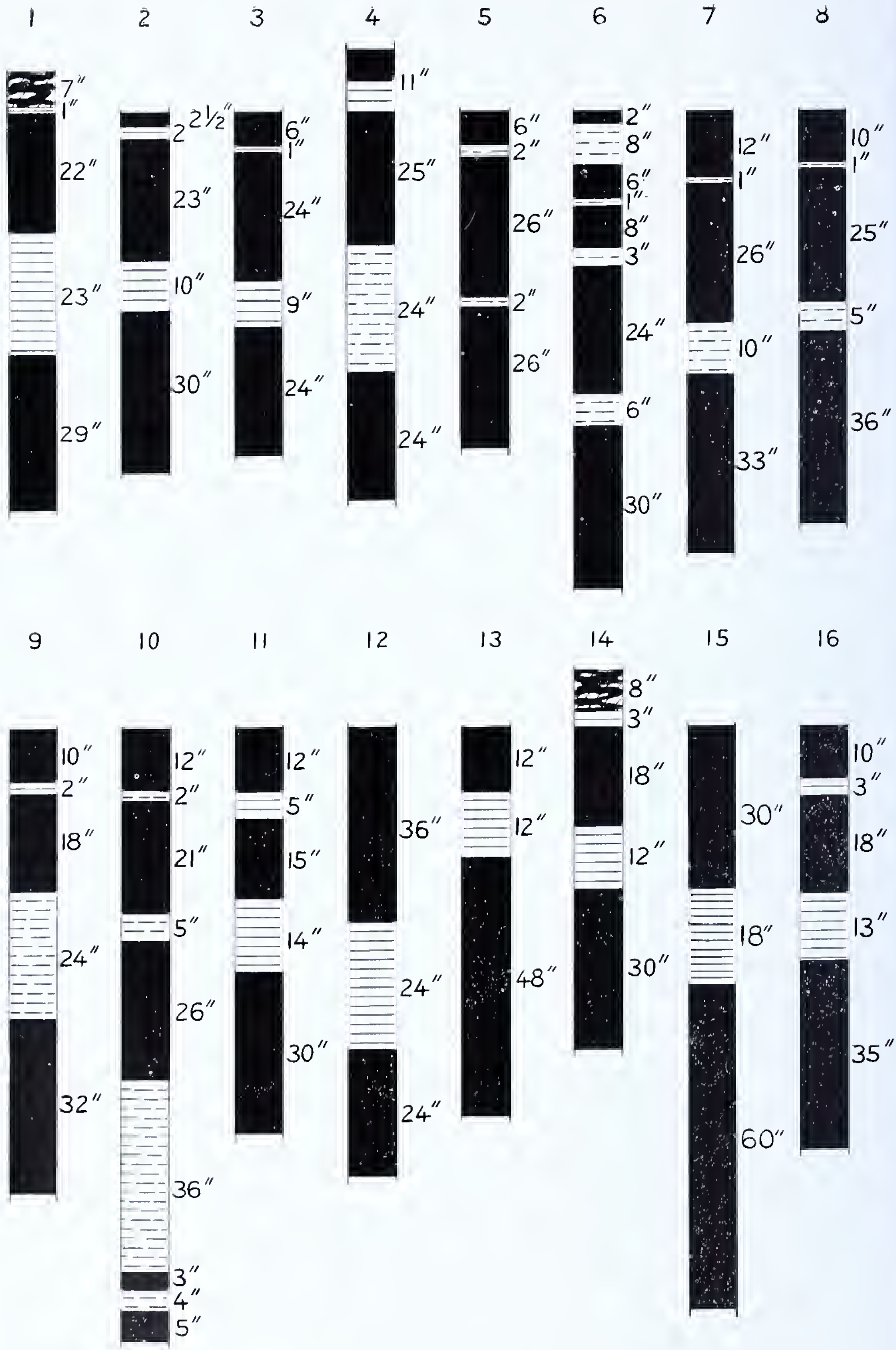

Fig. 26. Sections of Waynesburg coal.

1. Davistown, behind old steam mill.
2. Minor bank, northeast of Whiteley.
3. Southeast of Whiteley.

4. Near Wiley.
5. One mile west of Willow Tree.
6. Below mouth of Whiteley Creek.
7. Valley Fork of Little Whiteley Creek.
8. Near Ceylon.
9. Former opening 1 mile east of Carmichaels.
10. Outcrop on Muddy Creek north of Carmichaels, Cumberland Township.
11. Burson school house, Bush Run.
12. South of Clarksville, hillside south of.
13. North of Clarksville.
14. Country bank at Clarksville, Jefferson Township.
15. Arnold bank, northwest of Clarksville.
16. Country bank on Browns Run, Morgan Township.

This condition is not entirely local for in the river bluff directly east of this locality and about a quarter of a mile below the mouth of Whiteley Creek the Waynesburg bed has the following section:

Waynesburg coal below mouth of Whiteley Creek.

	Ft.	in.
Coal	0	2
Clay	0	8
Coal	0	6
Clay	0	1
Coal	0	8
Clay	0	3
Coal	2	0
Clay	0	6
Coal	2	6
	7	4

The Waynesburg coal outcrops along the road near Ceylon and many openings have been made in it in years past.

Waynesburg coal near Ceylon.

	At Ceylon		East of Ceylon	
	Ft.	in.	Ft.	in.
Coal	0	10	0	6
Clay	0	1	0	1
Coal	2	1	2	3
Clay	0	6	0	3
Coal	3	0	2	1
	6	6	5	2

The lower clay parting at Ceylon varies from 1 to 10 inches thick, and is persistently thick on Valley Fork of Little Whiteley Creek as shown in the following sections:

Waynesburg coal on Valley Fork of Little Whiteley Creek.

	Ft.	in.	Ft.	in.	Ft.	in.
Coal	1	0	1	0	0	8
Clay	0	1	0	½	0	½
Coal	2	2	2	1	1	11
Clay	0	10	0	8	1	0
Coal	2	9	2	11	3	2
	6	10	6	8½	6	9½

These sections were measured about a mile from the main creek by Stevenson[1] about 50 years ago.

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[1] Second Pennsylvania Geological Survey, Report K, p. 120.

Other sections of the Waynesburg coal measured many years ago when country banks were open at those localities are as follows:

Waynesburg coal near Wiley and Willow Tree.

	Near Wiley				Willow Tree	
	Ft.	in.	Ft.	in.	Ft.	in.
Coal	0	11	0	10	0	6
Clay					0	2
Coal	2	1	1	9	2	2
Clay	2	0	1	9	0	2
Coal (seen)	2	0	4	0	1	11+
	7	0	8	4	4	11+

Davistown. On Meadow Run just above Davistown, Albert Gaskel mines the Waynesburg coal on the Jasper Williamson farm, and below the concrete bridge at Davistown this coal is mined on the Litman Bros. farm by Silby Darr and Lewis Vance. The coal at Davistown is well known to be in two definite benches, both good coal. The bottom bench is 2½ to 3 feet and the top one 18 inches to 2 feet, but the shale that separates them is erratic, ranging from 3 inches to 20 inches or more. Where the parting is thin the two benches close together make a nice mining proposition. An overlying bony coal is left in the roof.

Mount Morris. On Morris Run, a small branch of Dunkard Creek that mouths at Mount Morris, the Waynesburg coal is just above water level ½ mile southeast of the village. There are several coal banks in the neighborhood but all north of the State line were idle in the fall of 1926 except one. The coal is beautifully exposed in a cut at a curve in the concrete highway a quarter of a mile north of the State line, as well as in the coal banks. The main fuel supply for Mount Morris is from a mine owned by the Mount Morris Realty Company and operated by Arthur and Joseph Lawson. The benches of the Waynesburg coal vary in thickness. A measurement made by the writer with Mr. Lawson is as follows:

Waynesburg coal at Mount Morris.

	Ft.	in.
Shale		
Bone coal		6
Clay parting		0¼
Bone coal		7
Coal	1	10
Shale (2″-30″)	1	2
Coal	1	6
Bone binder		2
Coal	2	0
Shale, floor		

According to Stevenson the following is an average section of Waynesburg coal on Morris Run:

Waynesburg coal at Mount Morris.

	Ft.	in.
Coal		6
Clay		4
Coal	2	0
Clay	2	6
Coal	4	6

At the head of Smiths Run, which forms the boundary between Dunkard and Perry townships south of Dunkard Creek, the Waynesburg coal was opened more than 50 years ago by Elie Russell, and ½ mile below by S. C. Donley. The bed in these coal banks had the following sections:

Waynesburg coal at head of Smiths Run.

	Russell		Donley	
	Ft.	in.	Ft.	in.
Coal	1	2	1	0
Shale		2		2
Coal	2	1	2	4
Shale	2-3	0	1	4
Coal	2	9	2	6

On the William Donley land ¾ mile below the mouth of Smiths Run at the roadside 90 feet above Dunkard Creek, at Squire Donley's opening half a mile west of Smiths distillery, and at Smiths distillery where the coal is 250 feet above the creek the following sections were measured by I. C. White in 1875.

Waynesburg coal on Dunkard Creek.

	William Donley		Squire Donley		Smith's distillery			
	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.
Sandstone	40	0	40	0				
Shale	2	0	8	0				
Coal	1	0		10	1	2	1	3
Shale		2		2		2		1½
Coal	2	6	2	4	1	10	2	4
Shale	1	4	2	8	2	8		5
Coal	3	0	2	7	3	0	3	6

The shale over the coal at the Donley openings is sandy and very rich in plant remains which are very well preserved. The measurements made at the Smith distillery, one at the mouth, and the other 20 feet in from the mouth of a drift, show the great irregularity in the main "horseback." Here it changes from 32 to 5 inches in 20 feet.

Jefferson. In former reports several measurements have been given showing the Waynesburg coal much parted in the mines under the village and in places very thick. Two measurements made by L. D. Woodworth in January 1922 show these conditions.

The S. J. Fulton drift mine is in the ravine at the west end of the village and the N. P. Rogers mine is at the road forks ¼ mile north of the bridge over Tenmile Creek.

Sections of Waynesburg coal at Jefferson.

	Fulton		Rogers	
	Ft.	in.	Ft.	in.
Roof coal		10		8
Slate		2		3
Bony coal				2
Coal	2	3	2	0
Clay	1	5	1	4
Bony coal				3
Coal	1	8	1	6
Bony coal				¼
Coal				3
Coaly shale		2		6
Coal	1	4½	1	0
Slate				2
Bottom coal				8
Slate				

John W. Trew was working the Fulton bank in 1926. The massive Waynesburg sandstone closely overlies the coal bed and makes a good roof.

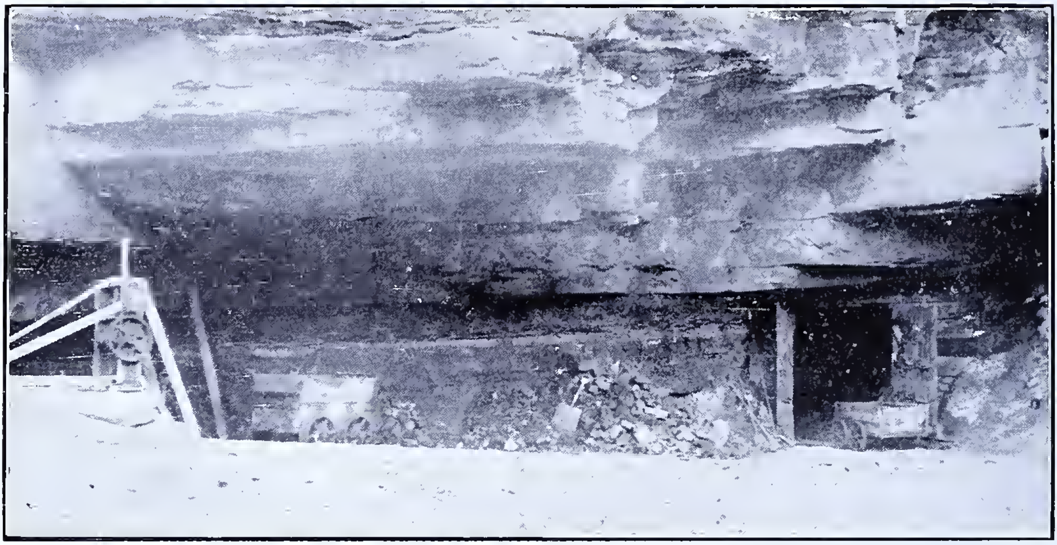

Fig. 27. Fulton bank in Waynesburg coal at Jefferson.

On the south side of Tenmile Creek one mile above Jefferson the Bell Fuel Coal Company of Jefferson owns 150 acres and has opened a bank but is waiting the extension of the railroad before developing the property.

At the mouth of a hollow 1 mile southwest of Jefferson a custom bank on the Waynesburg coal is operated by Bert Milligan, John Stewart, and Les Reynolds. In the mouth of a ravine 1½ miles southwest of Jefferson and just above the surveyed line of the proposed railroad Jack Davis has a coal bank in which the following section was measured:

Waynesburg coal in Jack Davis farm.

	Ft.	in.
Sandstone	20	
Shale, gray, sandy, 4 ft. to	1	6
Coal, sulphurous		10
Shale, hard, black		2
Coal	2	0
Shale, 8 inches to	1	6
Coal	3	0

Davis has a cable and bucket for hoisting the coal up the steep bank to a platform in his garden. The Waynesburg sandstone is exposed in the ravine and the coal is fairly well exposed where it makes a 5 foot fall in the run.

Still further up Tenmile Creek at the sharp bend 1¼ miles below the mouth of Ruff Creek on Patterson land leased by Milton Waters the Waynesburg coal has been opened in the south bank in a dozen places in 200 yards. The shale between the coal and overlying sandstone varies in thickness, but is about 5 feet thick. Joe Morris was mining in one of the openings in 1926. According to him and to the writer's measurements the coal is in two main benches, the upper one 2 feet thick and the lower one 3 feet with a shale parting from 12 to 30 inches

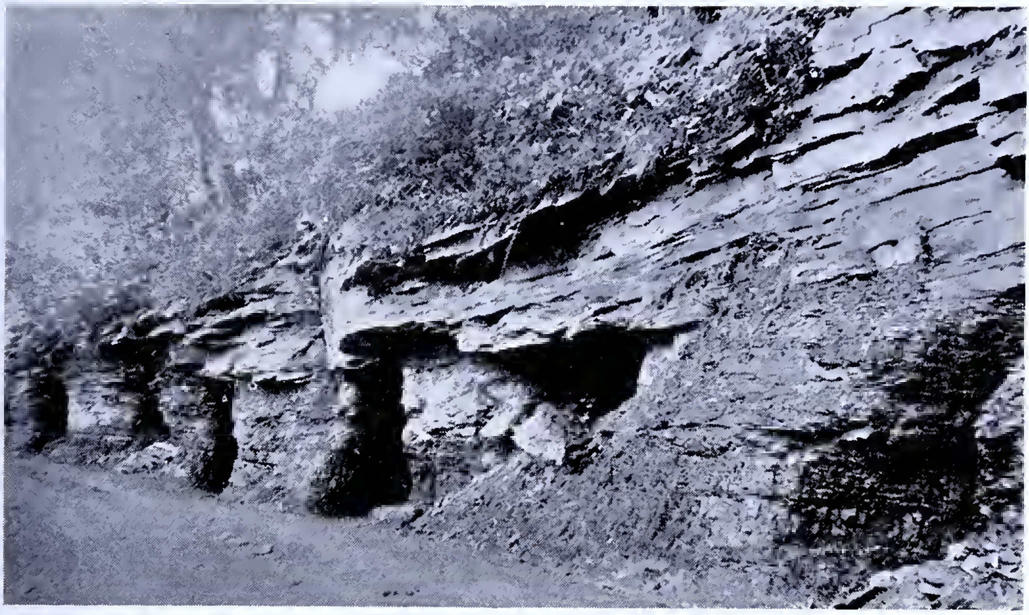

Fig. 28. Waynesburg coal banks on Tenmile Creek 2 miles southwest of Jefferson.

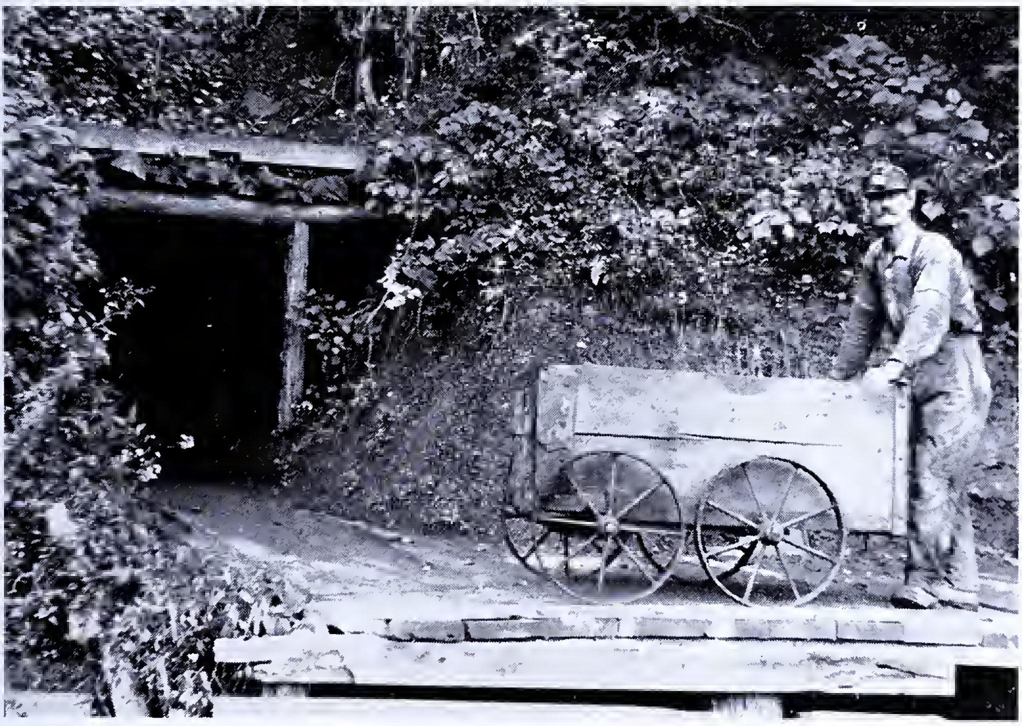

Fig. 29. Typical country coal bank, mined by Joe Morris

thick between them. An 8-inch band of hard platy coal occurs 16 inches below the top of the lower bench. This harder coal, Morris says, burns satisfactorily in a furnace but not in a range. Above the upper bench is a 2-inch "hard shell" and 8 inches of sulphurous coal that is left in the roof.

In the steep bluff on the opposite side of the creek the shales between the coal and sandstone are much thicker, as clearly exposed at the mouth of an old coal bank.

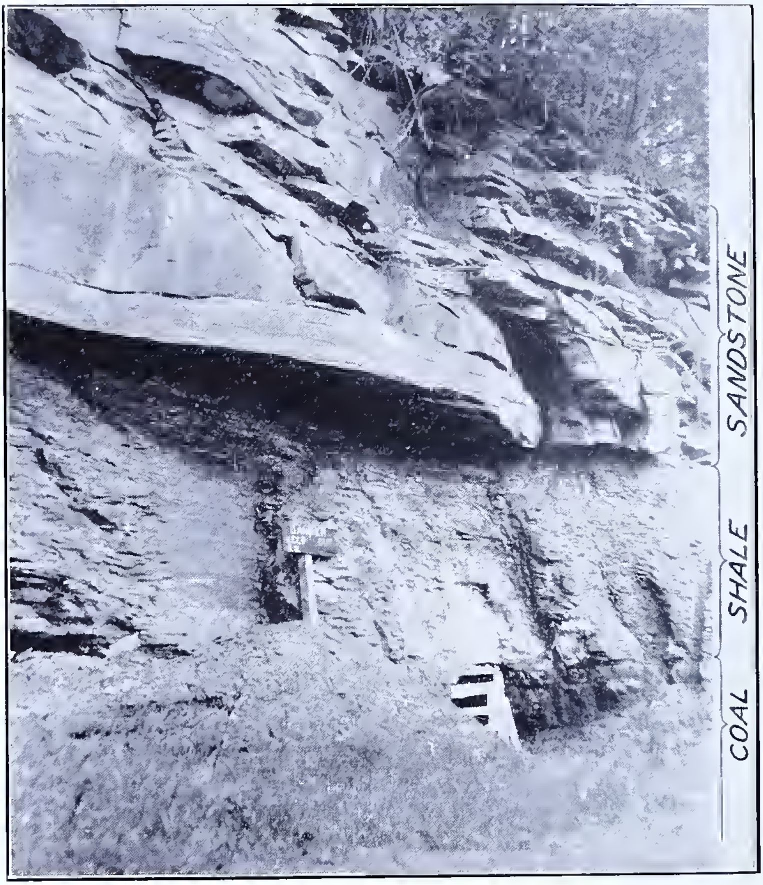

Fig. 30. **Waynesburg sandstone, shale, and coal in the bank of Tenmile Creek at end of bridge 2 miles southwest of Jefferson.**

Three miles west of Jefferson where the State highway crosses Ruff Creek a mine on the Waynesburg coal opened about 1924 by R. E. Kent, was operated later by D. Cramer. The drift had been driven about 500 feet by the end of 1925. According to Cramer, the sandstone rests directly on the coal, the top bench is 12 to 18 inches of good coal, the main parting has the same variation in thickness, and the bottom bench is 3 feet of good coal. Under these is 6 inches of bone and coal left down for floor.

Lippincott. At Lippincott there are several abandoned banks on the Waynesburg coal just below the village and a good exposure at the road forks. The only bank operating in 1926 was that worked by J. C. Kindle and owned by Mrs. J. B. Crayne.

Waynesburg coal in Crayne bank at Lippincott.

	Ft.	in.
Sandstone, thin, platy	20	
Shale, drab	4	
Shale, black	2	
Roof coal	2	
Shale, gray	1	
Coal (worked)	3	4
Coal, floor	0	4
Fire clay		

In 1926 lump coal at this bank sold for 10 cents bushel and slack for 5 cents.

Waynesburg. Several small mines are more or less actively engaged in providing Waynesburg with coal. Perhaps the largest is the Pratt Hill mine of the Mack Coal Company, operated by W. F. McLay. It is directly on the State highway 3 miles east of Waynesburg and so is very accessible for trucks. This company had the contract to supply the fuel needs of some of the largest consumers in Waynesburg.

In the fall of 1925 the mine was employing 7 men. It is a drift mine having a slate roof and clay floor. An electric mining machine and an electric pump are operated by purchased power. This mine was sampled at one point by L. D. Woodworth on January 16, 1922.

Section of Waynesburg coal bed in Pratt Hill mine.

Laboratory No.	83782	
	Ft.	in.
Coal	1	9
Clay*	1	2
Coal	2	10
Thickness of bed	5	9
Thickness of sample	4	7

*Not included in sample.

The Mack Coal Company stopped operating this mine in the spring of 1928. The coal has been mined far back from the outcrop; the mine is down the dip, is bothered by water; and furthermore it is an expensive mining operation where 14 inches of clay in the midst of the bed has to be handled.

The next operating mine nearer town is that on the farm of D. A. Cosgray on the north side of Tenmile Creek and three-quarters of a mile west of the Pratt Hill mine. Mr. Cosgray bought the property about 1912 but the mine is said to have been in existence forty years. The 300-foot drift is driven up the slope and so has natural drainage. According to the miners the floor is "hard slate"; the bottom coal 3½ feet, is overlain by shale ½ to 2 inches thick that in places rolls up to 12 inches. The top coal is 12 to 18 inches thick and the roof is shale. The coal has a good reputation and although ¾ of a mile from a hard highway, is in demand by people to whom other coal banks are more accessible.

On the William Pratt farm about 100 feet from the Cosgray mine is a coal bank which unfortunately was driven down the dip and has not been operated for several years because filled with water.

Several other openings on the Waynesburg coal on the north side of Tenmile Creek are idle.

On Braden Run below the County Home this coal has been mined for many years as is evidenced by a dozen openings in various stages of use and disuse. These are under the massive Waynesburg sandstone and some, although not operated for several years, can still be entered. The first mine below where the run babbles and cascades over ledges of the Waynesburg sandstone is worked by the Superintendent of the County Home to provide about 7,000 bushels annually for that institution. In November 1925 this new mine had an 80-foot drift down the dip and a 40-foot right turn, and one miner was producing about 70 bushels daily. The breast shows above the shale floor a 36-inch bottom coal, 12 inch shale parting, and 20-inch top coal, with only 2 inches of draw slate between it and the sandstone roof.

Two unused openings on the opposite side of the creek are the first of a series close to water level along the run. The only other coal

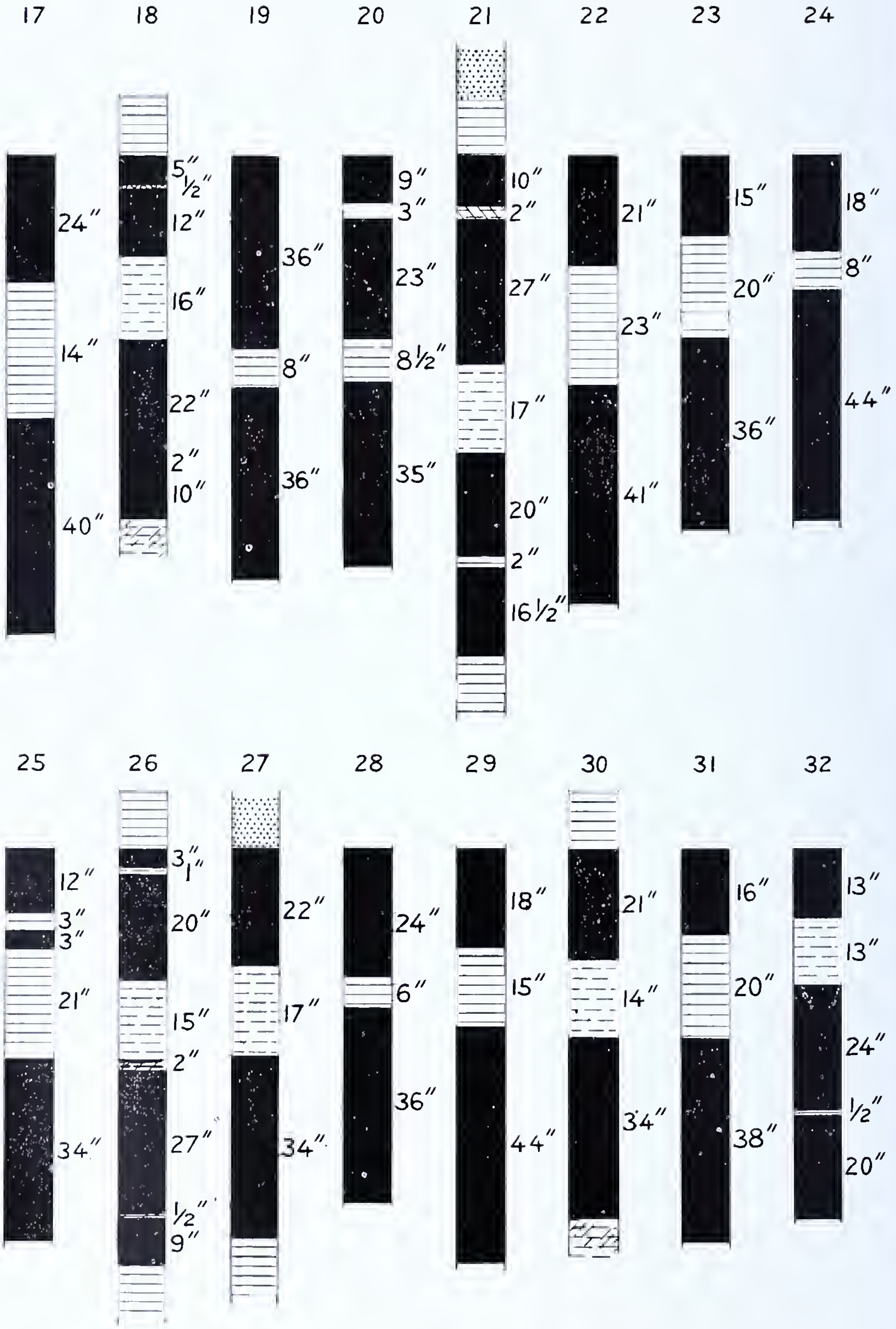

Fig. 31. Sections of Waynesburg coal.

17. Two miles southwest of Jefferson.
18. Dr. Hoge. ½ mile west of Rices Landing.
19. Two miles northeast of Jefferson.

20. Rex bank, 1 mile east of Jefferson.
21. Fulton bank, Jefferson.
22. Braden Run.
23. Lippincott, 1½ mile south on Ruff Creek.
24. Ankrom bank, 4 miles east of Waynesburg.
25. Two miles east of Waynesburg.
26. A. L. Moredock, 1½ mile southeast of Waynesburg.
27. Guthrie mine, 1½ mile southeast of Waynesburg.
28. Two and one-quarter miles east of Waynesburg.
29. At pump station 2 miles east of Waynesburg.
30. Mack Coal Company, Pratt Hill mine, east of Waynesburg.
31. Between Durbin and Crows Mills.
32. Durbin.

bank operating in 1925 was worked by Samuel Pitcock at the mouth of a small ravine ½ mile below the County Home. According to him the Waynesburg bed shows wide variation in thickness of the parting between the two benches. The lower coal bench is rather persistently 30 to 36 inches thick, but the shale parting ranges from 18 to 42 inches. The lower coal bench is thinnest where the shale parting is thickest. The upper bench is 12 to 18 inches. A blocky fracture and bright luster make this coal very attractive when neatly piled on the loading platform.

On Laurel Run along the Waynesburg-Mount Morris concrete road, there is a small group of mines within a mile of Waynesburg. The first of these is a drift mine just above the first fork of the run, and between the road and the run. This is the Moredock mine, that was operated for a number of years, and closed about 1923 because of trouble with water and with the roof which was coming down. Sections were measured in this mine by L. D. Woodworth on January 17, 1922.

Sections of Waynesburg coal bed in Moredock mine.

Section	A		B	
Laboratory No.	83814		83815	
	Ft.	in.	Ft.	in.
Coal		3		
Bony coal*				3
Clay*		1		
Coal	1	8	1	7
Clay*	1	3	1	4
Bony coal*		2		2
Coal	2	3	2	8
Slate*		½		
Coal		5		
Floor coal*		4		4
Thickness of bed	6	5½	6	4
Thickness of sample	4	7	4	3

*Not included in sample.

On the east bank of Laurel Run just above the Moredock mine is the Frank Lapping mine, operated in 1925 on lease by W. H. Flower. This mine is entered by a short slope to about 8 feet below creek level. The drift runs east up the flank of the Bellevernon anticline for about 650 feet. Loaded cars and the small quantity of water made by the mine run by gravity to the foot of the slope, where the cars are pulled out by a steam winch. The water is removed by running a 3-inch pump about two hours daily. According to Mr. Flower the floor is very wavy but the bottom coal is regularly 28 inches thick. The parting ranges from 6 inches to 3 feet thick and averages about 14 inches. The top coal may be anywhere from 6 to 18 inches thick but commonly is 12. A horseback of platy shale about 3 feet thick separates the coal from the Waynesburg sandstone. The product is run-of-mine coal for local domestic use.

The Guthrie mine is a quarter of a mile farther up the run and 2 miles from Waynesburg. It is entered by a short slope in the creek bank. The floor of the coal is encountered 18 feet below creek level and the drift about 500 feet long is driven up the dip. In November 1925 six miners were employed by John Chappell who operates the mine on a lease. Mining is by hand because the output of 2,000 to 3,000 tons per year does not warrant a mining machine. A 3-inch centrifugal pump operated one hour daily keeps the mine free of water. The roof is the Waynesburg coal and the floor is "slate." Measurements of the Waynesburg coal in this mine were made by L. D. Woodworth on January 17, 1922.

Section of Waynesburg coal bed in Guthrie mine.

Section	A		B	
Laboratory No.	83811		83812	
	Ft.	in.	Ft.	in.
Coal		11	1	10
Clay*	1	11	1	5
Coal	2	10	2	10
Floor coal*		3		3
Thickness of bed	5	11	6	4
Thickness of sample	3	9	4	8

*Not included in sample.

The Brick and Stone Company of Waynesburg began opening a mine in the Waynesburg coal in 1924 on the west side of Laurel Run on the road over the hill to Sugar Run. A slope reaches the bottom of the coal at 55 feet. When visited by the writer in November, 1925, three small bunkers had been built, a steam winch installed, and it was expected that production would begin that month. The coal would be used by the company for burning brick and raising steam at its plant on Smith Creek.

Durbin. In the western part of the county the Waynesburg coal lies far below the surface, approximating 400 feet at Graysville, 500 feet at Nineveh, 350 feet at Rogersville, and 400 feet at New Freeport. The only place where it outcrops is on Enlow and Dunkard Forks of Wheeling Creek. This outcrop is close to creek level and extends from the State line up Enlow Fork to within 1 mile of Burdette. A number of country banks have been worked along this stream but not in recent years. On Dunkard Fork the outcrop extends from the State line up to Crabapple. It has been mined in a small way at several places. The thickest development is at Durbin where under a cliff of Waynesburg sandstone the bed is exposed over 6 feet thick. The sandstone forms an excellent roof so that no timbering is necessary. The bed generally is in 2 or 3 benches separated by clay or shale. The following sections of this bed, which is locally called the Crabapple coal, are by Clapp.

Sections of Waynesburg coal.

	Between Durbin and Crows Mills		At Durbin	
	Ft.	in.	Ft.	in.
Coal	1	4	1	1
Clay	1	8	1	1
Coal	3	2	2	
Binder				½
Coal			1	8
	6	2	5	10½

In 1926 Price Cheek was mining the Waynesburg coal on the Walter Gray property and reported the breast 300 yards from the mine mouth which is under a sandstone ledge on the creek bank. The output of this bank is 25-30 bushels daily and the price is 16 cents for forked coal and 8 cents for slack.

The Drake mine in the opposite bank of the creek was idle, but Bryan Barnhart was opening a bank 100 yards below Dinsmore's store to fill a contract for 4,000 bushels for the township schools. The coal banks on Crabapple Creek are abandoned and fallen shut.

Another country bank on the Waynesburg coal is on the north side of Wheeling Creek 1½ miles below Durbin and just below the iron bridge. It is worked by Charles Ramer.

Waynesburg coal near Durbin.

	Cheek		Ramer	
	Ft.	in.	Ft.	in.
Sandstone				
Roof coal	1	0		10
Shale	1	0	1	3
Bone and coal		5		8
Coal	2	5	2	8
Clay	1			

The roof coal is not everywhere present and it with the underlying shale is not taken down. The coal from these two banks supplies the farmers in a considerable area in the western part of the county.

On Dunkard Fork the thickness of the coal is variable on account of rolls or depressions of sandstone from the roof which may cut out one or more benches of the coal.

A sample of the Waynesburg coal from the bank opposite Durbin was analyzed many years ago.

Analysis of Waynesburg coal at Durbin.

[E. E. Somermeier, analyst]

	Per cent
Moisture	2.79
Volatile matter	36.05
Fixed carbon	48.35
Ash	12.81
	100.00
Sulphur	3.77

Another analysis will be found on a later page.

The coal is being mined at present between Durbin and Crabapple to supply the farmers over a considerable area in the western part of the county.

WAYNESBURG A AND B COALS.

From Monongahela Township on the east to Springhill Township on the west, coal bloom is likely to be found in the road 40 to 100 feet above the Waynesburg coal. That occurring at 40 to 80 feet is the Waynesburg A, a persistent bed on top of the Waynesburg sandstone. Traces of this coal in the northern half of Monongahela Township indicate that the bed is about 2 feet thick. It has not been mined or prospected here, however, and the actual thickness of coal is not known. Just below the mouth of Little Whiteley Creek it is 18 inches, and on Muddy Run above Carmichaels 3 feet 6 inches, a thickness that induced someone to mine it but which presumably is only a local development. In the valley of Castile Run its thickness is 16 inches; in Franklin and Greene Townships, 18 inches, and in Cumberland Township it reaches 2 feet.

The Waynesburg A coal is well exposed above the Waynesburg sandstone near Crabapple and at Ryerson Station, where it measures 19 inches. Here the upper 5 inches is largely shale, and of course a bed carrying barely 14 inches of coal is not mined.

The Waynesburg B coal is thick enough to form a small blossom in the road and in places may carry a foot of coal, but nowhere is it thick enough to mine or to be considered as a future source of fuel. In some places it is little better than bituminous shale. It is separated from the Waynesburg A bed by 20 to 40 feet of limestone and sandstone. Where exposed on Smith Creek the Waynesburg B is about 1 foot thick.

LITTLE WASHINGTON COAL.

Concerning the Little Washington coal Stevenson says (Report K, p. 54) that "throughout Greene County it is a mass of dark, slightly bituminous shale, sometimes containing two or three inches of coal. The carbonaceous matter is not well aggregated at any place in the county except on Mill Run, in the extreme north-west corner, where it forms a coal bed ten inches thick, and the rest of the shale is not black, but drab." Mill Run is described as entering Hunters Fork at Clouse's Mill (now Burdette).

According to Clapp (Rogersville folio No. 146, p. 13) the Little Washington coal, occurring about 100 feet above the Waynesburg coal, is well exposed near Crabapple and at one place in Richhill Township is a foot thick. This bed has no value.

WASHINGTON COAL.

The blossom of the Washington coal makes a black smudge in the roads crossing the higher hills in eastern Greene County but the bed has not been prospected or well exposed for measurement because it is apparent that the bed, although thick, is mostly black shale and contains very little coal.

In the village of Waynesburg, near the first bridge over Purman Run, this coal bed was measured by the Pennsylvania Second Geological Survey, and it is exposed at several places on the Smith Creek road a mile south of Waynesburg station.

Washington coal at Waynesburg.

	Purman Run		Smith Creek	
	Ft.	in.	Ft.	in.
Coal	0	8	0	9
Clay	0	5	0	5
Coal	1	3	0	5
	2	4	1	7

Not more than 5 inches of the lower bench on Purman Run is good coal. The writer found a thin coal bed exposed in front of houses a few rods north of the covered bridge over Purman Run and in the road a block farther north. Limestone outcrops about 5 feet below it. This same limestone 18 inches thick and overlain by coal outcrops 50 feet south of High Street on East Street in Waynesburg.

The outcrop in the bank of Smith Creek on the Ed. Cummins farm 1 mile south of Waynesburg was measured by the writer.

Washington coal on Smith Creek.

	Ft.	in.
Sandstone	2	0
Shale, gray	2	6
Coal	0	9
Shale	0	6
Coal	0	5
Shale, black	1	6
Limestone	0	6

In most of the western part of the county the Washington coal is deep below the surface. It comes to the surface again in Richhill Township and was formerly mined in a small way at a number of banks near Ryerson Station and on Crabapple Creek. The difficulty and unprofitableness of mining this coal is shown by the following sections.

Washington coal near Ryerson Station.

	1 mile northeast			1 mile northwest	
	Ft.	in.		Ft.	in.
Coal		5	Coal		½
Clay		1½	Clay		½
Coal		2	Coal		1
Clay	1	0	Coal and bone		6
Coal		3	Coal	1	6
Clay		5			
Coal	1	11			
	4	3½		2	2

This coal outcrops in the hill above the Waynesburg coal at Durbin and Crabapple and is called the Bond coal. It is said to be as thick as the lower bed, but is no longer mined here, nor at any place in Greene County.

It cannot be counted on as a source of future supply for where the bed is thick, barely more than half of it is coal and that in several benches, and at other places the coal is either very thin or absent.

A sample taken according to standard method and analyzed by the U. S. Geological Survey shows that the coal is high in sulphur and ash and low in fixed carbon.

Analysis of Washington coal 1 mile northwest of Ryerson Station
[E. E. Somermeier, analyst].

Moisture	2.22
Volatile matter	36.79
Fixed carbon	46.96
Ash	14.03
	100.00
Sulphur	3.79

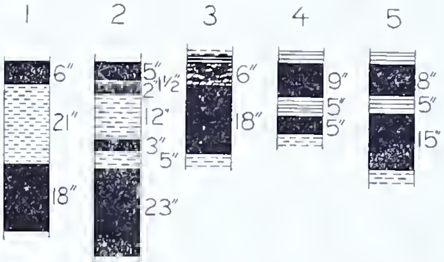

Fig. 32. Sections of Washington coal.

1. Country bank, 1 mile north of Ryerson Station above Baldwin's mill.
2. Country bank, 1 mile northeast of Ryerson Station.
3. Outcrop 1 mile northwest of Ryerson Station.
4. Outcrop 1 mile south of Waynesburg on Smith Creek.
5. Outcrop at Waynesburg.

The position of the Washington coal is 115 to 180 feet above the Waynesburg coal and just below the Lower Washington limestone.

TENMILE COAL.

In the vicinity of Graysville, Richhill Township, occurs a bed of coal one foot thick that may be a local development. Clapp reports it to be 50 to 100 feet above the Upper Washington limestone.

JOLLYTOWN COAL.

At a distance ranging from 150 to 200 feet above the Washington coal, a blossom may be found where roads cross this horizon in the western part of the county. A coal bed 2 to 12 inches thick and only a few feet above Tenmile Creek between Rogersville and the mouth of Pursley Run is believed to be at the same stratigraphic horizon as the one which crosses the road at the west end of the village of Jollytown. Stevenson says that the Jollytown coal 20 inches thick was mined in two places within a mile east of Jollytown to provide fuel for adjacent mills. In the 50 years that have passed since this observation, natural gas from wells drilled in this vicinity has supplanted the local coal and it has not been mined for many years. This coal used to be exposed also near the mouth of Hoover Run and farther up that run in Wayne Township.

When the writer visited Jollytown in September 1926, he found a roadside exposure ¾ mile northwest of the village which showed about 3 feet of impure limestone overlain by 1 foot of soft shale and 11 inches of coal. Opposite Dye's store at the west end of Jollytown a coal is exposed which does not appear to be over 1 foot thick. Just below Jollytown this coal was opened over 50 years ago. It proved to be 20 inches thick, a kind of semi-cannel, containing "some slate and sulphur." This coal also was once mined in the bank 55 feet above the creek on the John Lantz farm 2 miles east of Jollytown. Here it is 21 inches thick and has 2 feet of limestone 24 feet above it. When in this region in 1875 as aid to John J. Stevenson, I. C. White found that more than 2,000 bushels of Jollytown coal had been stripped on the land of John Cox along Dunkard Creek just east of the Gilmore Township line. The bed was 22 inches thick but contained "much slate and sulphur." This coal is 130 feet above creek level at the mouth of Hoovers Run, and 200 feet above Rudolph Run near the State line.

DUNKARD COAL

Just under the Fish Creek sandstone and about 200 feet above the Upper Washington limestone a thin coal bed is found fairly well distributed in the western part of the county. The bed is of so little value that it is not being dug at any place although in the 1870's it was a regular source of supply for a few people. It could be dug to advantage only where the overburden was so thin that the coal could easily be uncovered and raised by stripping. Stevenson refers in Report K of the Second Geological Survey to several places where the Dunkard coal could be measured. Some of the locality descriptions are not so definite as might be wished.

In Center Township the Dunkard coal was stipped on Scott Run half a mile above the mouth where the bed was 20 inches thick but carried a clay parting. This locality is 1 mile east of Rutan. It was dug also on Wood Run, a tributary of McCourtney Run at the Jackson Township line, in two places.

In Jackson Township it was dug long ago on Garner Run at the church below White Cottage and in Aleppo Township at two places.

Dunkard coal in Center and Aleppo Townships.

	Wood Run		Harts Run	Mudlick Fork
	inches	inches	inches	inches
Coal	11	8	10	11
Clay	1	1	4	3
Coal	8	5	8	10
	20	14	22	24

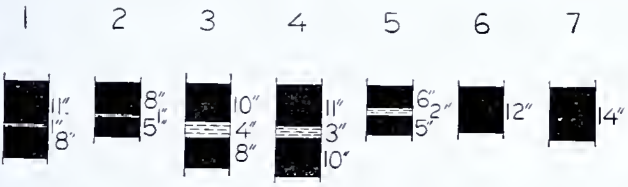

Fig. 33. Sections of Dunkard coal.

1. Wood Run. 2. Wood Run. 3. Harts Run. 4. Mudlick Fork. 5. Gilmore Township. 6. White's mill. 7. Wagonroad Run.

The Hart Run locality is half a mile from the West Virginia line and on Mudlick Fork the coal was mined in a drift 50 feet long on the Murray farm.

In Gilmore Township this coal was then mined on the main fork of Dunkard Creek (a very indefinite place) where the bed is 13 inches thick, including 2 inches of clay in the middle. At the mouth of Negro Run in the same township it measured 14 inches.

In Springhill Township opposite the mouth of Herod Run just below New Freeport the Dunkard coal is present about 10 feet below the massive Fish Creek sandstone. A little farther down Fish Creek at White's mill the Dunkard coal is barely 1 foot thick but it was dug for years for local use. It is 14 inches thick where it goes below creek level at the mouth of Wagonroad Run. A mile or more below the mouth of Wagonroad Run in a little tributary of Fish Creek the Dunkard coal is 13 inches thick with 2 inches of clay in the middle. This coal outcrops for about 2 miles along Bissett Run.

At Deep Valley in the south bank of Fish Creek 100 yards or so below the covered bridge and 50 feet above the creek, coal was once mined by long drifts, according to old residents. The bed is said to be in two benches, each about one foot thick, and separated by 18 inches of "horse." This coal has been mined also at the school at the mouth of Pigeon Run both in the creek bank and along the road up the run. According to report the top bench is 18 inches, the bottom bench 5 inches, and the "slate" parting 2 to 7 inches. The writer is not certain of the correlation of the coal at these places.

NINEVEH COAL.

A thin coal named from a settlement in Morris Township is fairly persistent in western Greene County. It has been recognized in Morris, Center, Jackson, Aleppo, Gilmore, and Springhill townships as occurring 140 feet or more above the Dunkard coal. It is hard to find this coal well exposed now but in the days of the Second Geological Survey it was dug and used at several places where the cover was so thin that the coal could easily be stripped. These strippings were limited usually to a few hundred bushels of coal at any one locality.

At most of these localities no trace remains of these operations for they were on the flood plain of small streams and in 50 years soil has covered the shallow excavations.

The Nineveh coal used to be exposed on Browns Creek below Nineveh and was mined in a little run half a mile above the mouth of Brush Fork in Morris Township. At both of these places the bed was 18 to 20 inches thick. This coal has been stripped on the Mason Lightner farm 1 mile southeast of Nineveh where it outcrops in a ravine east of his house and 700 feet north of the road. It is said to be 20 inches thick and a little was stripped in 1922. Many years ago it was stripped in the run half a mile north of his house. Traces of it have been found in the creek above Rutan and a mile below Graysville.

On Wood Run, a fork of McCourtney Run at the Jackson Township line, the Nineveh coal is 8 inches thick, and just above White Cottage 6 inches.

Stevenson reports that the Nineveh coal used to be mined at the extreme head of Dunkard Creek where it was only 14 inches thick and he classed it as semi-cannel. On the north fork of Fish Creek 1½ miles above New Freeport it was 22 inches thick but not all coal. The distance to a thicker coal bed was so great that local demand accomplished the stripping of this thin bed.

A bed of coal whose stratigraphic position was not determined is exposed at the road forks three-quarters of a mile east of Ryerson Station. The bed is 28 inches thick, but contains many cardboard-thick layers of shale. It was once mined by stripping in the ravine near by.

COAL RESOURCES.

BY JOHN F. REESE

INTRODUCTION.

Greene County contains one-fourth of the Pittsburgh coal in the State, and has more unmined coal than any other county. The coals beneath the Pittsburgh, in the Allegheny group, do not outcrop in the county, and little is known of their thickness and value.

Greene County has at least eight workable coals. The Pittsburgh is the only one that can be worked in large areas; the others are workable only locally. Thirty beds are known in the county with an aggregate average thickness of approximately 25 feet.

Practically all of the coal production of Greene County comes from mines along or near Monongahela River. Development of coal in the interior of the county has been hampered by lack of railroad facilities and because the Pittsburgh coal is more accessible in the river valley.

COAL BEDS.

Four beds are of economic interest and have been used in calculating the quantity of coal in the ground. These beds in order of present importance are the Pittsburgh, Sewickley, Waynesburg, and Freeport.

Pittsburgh coal. The mining and prospecting of the Pittsburgh coal has furnished measurements of its thickness in several places and with data from contiguous areas in West Virginia, a fairly reliable computation of the quantity is possible. The Pittsburgh coal underlies all the county except a narrow strip on Monongahela River.

Sewickley coal. The Sewickley coal underlies practically the entire county and is exposed only in the southeast part and at the mouth of Tenmile Creek. Mines on the outcrop and data from adjacent parts of West Virginia furnish the only data for computing the tonnage. An average of 20 inches has been used in townships for which no measurements can be obtained.* This coal is thickest in the southeast part of the county and thins rapidly toward the north and west.

Waynesburg coal. Numerous sections from the extensive outcrop of the Waynesburg coal and data from reports of the West Virginia Geological Survey give a fairly accurate basis for computing the thickness of this coal in each township. This bed is broken by many partings and at present is used only locally. It will not be mined extensively for commercial use until railroads are built into the county or the Pittsburgh and Sewickley beds are nearer exhaustion.

Washington coal. Besides these four beds, a fifth, known as the Washington coal from its considerable development in the adjoining county, is of some interest. In much of the county where its horizon

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* This does not mean that the Geological Survey believes the coal is only 20 inches thick, but it conforms to the idea of being extremely conservative when there is a question as to the actual content of any bed.

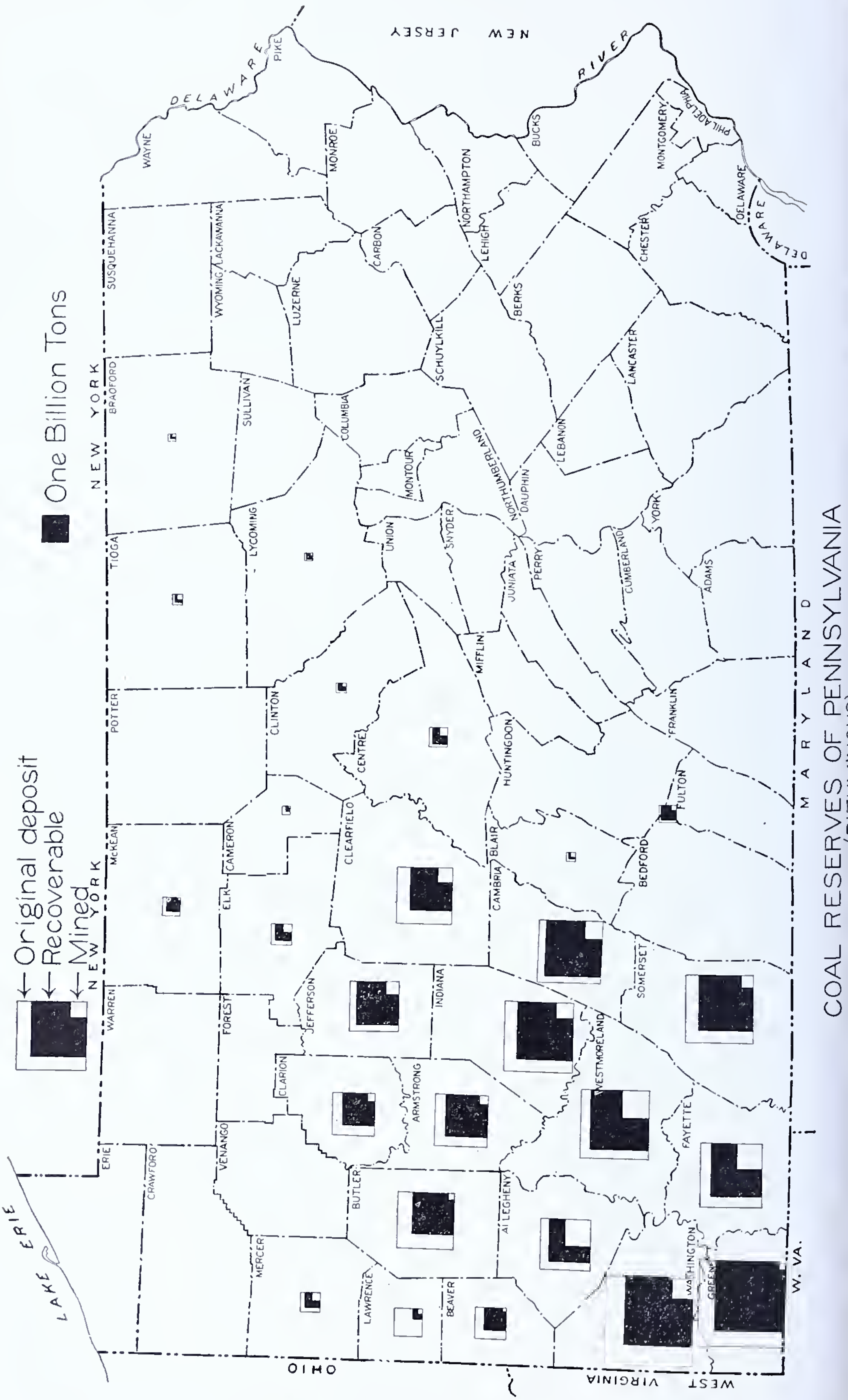

Fig. 34. Coal reserves in Pennsylvania.

is exposed the bed is so thin or composed so largely of clay and shale partings that it is not mineable. In the vicinity of Ryerson Station, however, at one place the bed is 51 inches thick and contains 33 inches of coal in four benches, the thickest of which is 23 inches. It has been mined at several banks in Richhill Township, but as the main bench rarely exceeds 18 inches, this bed is not considered as an economic resource.

Freeport coal. Little is known of the Freeport coal in Greene County except that the records of churn drill holes show coal at its horizon. The thickness along Monongahela River is known from records of core drill holes. This coal lies about 600 feet below the Pittsburgh coal; it does not outcrop and so is assumed to underlie the whole county at considerable depth and with unbroken continuity. In computing the quantity a thickness of 30 inches has been used in all townships. The recoverable quantity has been estimated at 50 per cent of the whole, from which has been deducted 15 per cent for loss in mining. This bed is ranked fifth because its regularity and extent are wholly assumed. Should future prospecting show it thicker and better than has been assumed, this coal may eventually be mined in spite of its great depth, and rank higher in economic value than the dirty but more accessible Waynesburg and Washington coals.

Other coal beds than these five have been mined for local use but as they are not important, and as little is known of their extent and thickness, they have not been included in the computation of the resources.

COAL RESOURCES.

The result of computing the coal resources in Greene County based on the latest maps, engineering data, and methods is shown in the following tables:

Coal resources in Greene County, in short tons.

Bed	Original deposit	Mined out and lost	Recoverable
Waynesburg	2,557,242,000	270,000	1,647,859,000
Sewickley	1,393,407,000	2,700,000	1,119,454,000
Pittsburgh	3,919,486,000	39,420,000	2,831,454,000
Freeport	1,594,080,000	----------------	677,484,000
Total	9,464,215,000	42,390,000	6,276,251,000

The reliability of the average thickness of the coals used in the computation of tonnage decreases for the several beds given from left to right and for the townships from east to west or from northeast to southwest. Thus, while the figures for the Pittsburgh bed are conservative and probably reliable, the figures for the Freeport coal may be much too small or many times too large.

Summary of recoverable coal in Greene County, in short tons.

Township	Pittsburgh	Sewickley	Waynesburg	Freeport
Aleppo	106,475,760	41,922,000	59,180,400	31,441,500
Center	224,206,200	78,030,000	141,827,175	58,522,500
Cumberland	245,342,845	77,838,750	114,255,425	46,473,750
Dunkard	166,906,170	99,488,250	36,762,075	36,949,500
Franklin	194,398,740	63,112,500	124,316,525	47,277,000
Gilmore	94,847,760	31,537,125	56,763,000	25,704,000
Greene	116,246,340	40,738,160	53,978,400	22,032,000
Jackson	119,034,000	44,370,000	85,068,000	33,277,500
Jefferson	127,937,070	41,248,800	61,419,930	26,277,750
Monongahela	97,711,920	49,778,550	15,353,550	20,999,250
Morgan	148,523,220	41,310,000	80,588,925	31,212,000
Morris	156,125,025	55,692,000	114,971,850	41,769,000
Perry	179,478,180	114,300,945	121,059,720	35,113,500
Richhill	228,276,350	93,024,050	167,638,275	69,768,000
Springhill	123,379,200	46,512,000	59,394,650	34,884,000
Washington	123,677,550	41,310,000	92,947,500	30,982,500
Wayne	199,106,550	99,410,220	141,525,000	47,047,500
Whiteley	179,781,120	59,830,650	120,808,800	37,752,750
Total	2,831,454,000	1,119,454,000	1,647,859,000	677,484,000

Coal resources in Greene County by townships.

Bed	Area (sq. mi.)	Original deposit	Mined out and lost	Recoverable	Mining per cent	Mining loss per cent	Range of thickness (inches)

Aleppo Township Area 27.4 square miles

Bed	Area (sq. mi.)	Original deposit	Mined out and lost	Recoverable	Mining per cent	Mining loss per cent	Range of thickness (inches)
Pittsburgh	27.4	156,582,000		106,475,760	80	15	60–66
Sewickley	27.4	49,320,000		41,922,000	100	15	20
Waynesburg	27.4	87,030,000		59,180,400	80	15	30–45
Freeport	27.4	73,980,000		31,441,500	50	15	30
Total		366,912,000		239,020,360			

Center Township Area 51.0 square miles

Bed	Area (sq. mi.)	Original deposit	Mined out and lost	Recoverable	Mining per cent	Mining loss per cent	Range of thickness (inches)
Pittsburgh	51.0	310,320,000		224,206,200	85	15	62–72
Sewickley	51.0	91,800,000		78,030,000	100	15	20
Waynesburg	51.0	238,365,000		141,827,175	70	15	50–60
Freeport	51.0	137,700,000		58,522,500	50	15	30
Total		778,185,000		502,585,875			

Cumberland Township Area 40.5 square miles

Bed	Area (sq. mi.)	Original deposit	Mined out and lost	Recoverable	Mining per cent	Mining loss per cent	Range of thickness (inches)
Pittsburgh	40.14	336,621,600	15,912,000	245,342,845	90	15	80–104
Sewickley	40.5	91,575,000		77,838,750	100	15	25
Waynesburg	29.2	158,139,000		114,255,425	85	15	50–72
Freeport	40.5	109,350,000		46,473,750	50	15	30
Total		695,685,000	15,912,000	483,910,770			

Dunkard Township Area 32.2 square miles

Bed	Area (sq. mi.)	Original deposit	Mined out and lost	Recoverable	Mining per cent	Mining loss per cent	Range of thickness (inches)
Pittsburgh	27.5	225,738,000	7,560,000	166,906,170	90	15	84–94
Sewickley	24.0	119,205,000	2,160,000	99,488,250	100	15	40–60
Waynesburg	12.6	61,785,000		36,762,075	70	15	50–65
Freeport	32.2	86,940,000		36,949,500	50	15	30
Total		493,688,000	9,720.000	340,105.995			

Coal resources in Greene County by townships—Continued.

Bed	Area (sq. mi.)	Original deposit	Mined out and lost	Recoverable	Mining per cent	Mining loss per cent	Range of thickness (inches)
Franklin Township							Area 41.2 square miles
Pittsburgh	41.2	269,064,000		194,398,740	85	15	68–80
Sewickley	41.2	74,250,000		63,112,500	100	15	20–25
Waynesburg	38.8	208,935,000		124,316,325	70	15	50–60
Freeport	41.2	111,240,000		47,277,000	50	15	30
Total		663,489,000		429,104,565			
Gilmore Township							Area 22.4 square miles
Pittsburgh	22.4	139,482,000		94,847,760	80	15	66–72
Sewickley	22.4	43,650,000		31,537,125	85	15	20–40
Waynesburg	22.4	83,475,000		56,763,000	80	15	35–45
Freeport	22.4	60,480,000		25,704,000	50	15	30
Total		327,087,000		208,851,885			
Greene Township							Area 19.2 square miles
Pittsburgh	19.2	151,956,000		116,246,340	90	15	80–94
Sewickley	19.2	56,385,000		40,738,160	85	15	25–50
Waynesburg	16.2	79,380,000		53,978,400	80	15	50–60
Freeport	19.2	51,840,000		22,032,000	50	15	30
Total		339,561,000		232,994,900			
Jackson Township							Area 29.0 square miles
Pittsburgh	29.0	175,050,000		119,034,000	80	15	60–72
Sewickley	29.0	52,200,000		44,370,000	100	15	20
Waynesburg	29.0	125,100,000		85,068,000	80	15	40–60
Freeport	29.0	78,300,000		33,277,500	50	15	30
Total		430,650,000		281,749,500			
Jefferson Township							Area 22.9 square miles
Pittsburgh	22.0	168,930,000	1,692,000	127,937,070	90	15	80–108
Sewickley	22.0	48,528,000		41,248,800	100	15	20–25
Waynesburg	18.2	96,345,000		61,419,930	75	15	50–60
Freeport	22.9	61,830,000		26,277,750	50	15	30
Total		375,633,000	1,692,000	256,883,550			
Monongahela Township							Area 18.3 square miles
Pittsburgh	16.75	141,264,000	13,536,000	97,711,920	90	15	92–100
Sewickley	15.5	65,610,000	540,000	49,778,550	90	15	25–60
Waynesburg	4.1	20,070,000		15,353,550	80	15	50–55
Freeport	18.3	49,410,000		20,999,250	50	15	30
Total		276,354,000	14,076,000	183,843,270			

Coal resources in Greene County by townships—Continued.

Bed	Area (sq. mi.)	Original deposit	Mined out and lost	Recoverable	Mining per cent	Mining loss per cent	Range of thickness (inches)
Morgan Township							Area 27.2 square miles
Pittsburgh	27.2	194,868,000	720,000	148,523,220	90	15	72–84
Sewickley	26.6	48,600,000		41,310,000	100	15	20–25
Waynesburg	22.9	126,414,000		80,588,925	75	15	48–90
Freeport	27.2	73,440,000		31,212,000	50	15	30
Total		443,322,000	720,000	301,634,145			
Morris Township							Area 36.4 square miles
Pittsburgh	36.4	216,090,000		156,125,025	85	15	62–68
Sewickley	36.4	65,520,000		55,692,000	100	15	20
Waynesburg	36.4	193,230,000		114,971,850	70	15	55–60
Freeport	36.4	98,280,000		41,769,000	50	15	30
Total		573,120,000		368,557,875			
Perry Township							Area 30.6 square miles
Pittsburgh	30.6	234,612,000		179,478,180	90	15	76–92
Sewickley	30.6	158,202,000		114,300,945	85	15	30–68
Waynesburg	28.4	178,029,000		121,059,720	80	15	55–100
Freeport	30.6	82,620,000		35,113,500	50	15	30
Total		653,463,000		449,952,345			
Richhill Township							Area 60.8 square miles
Pittsburgh	60.8	335,700,000		228,276,350	80	15	58–66
Sewickley	68.8	109,440,060		93,024,050	100	15	20
Waynesburg	60.2	282,015,000	270,000	167,638,275	70	15	30–60
Freeport	60.8	164,160,000		69,768,000	100	15	30
Total		891,315,000	270,000	573,225,675			
Springhill Township							Area 30.4 square miles
Pittsburgh		181,440,000		123,379,200	80	15	62–68
Sewickley	30.4	54,720,000		46,512,000	100	15	20
Waynesburg	30.4	87,345,000		59,394,650	80	15	30–40
Freeport	30.4	82,080,000		34,884,000	50	15	30
Total		405,585,000		264,169,850			
Washington Township							Area 27.0 square miles
Pittsburgh	27.0	171,180,000		123,677,550	85	15	68–76
Sewickley	27.0	48,600,000		41,310,000	100	15	20
Waynesburg	27.0	145,800,000		92,947,500	75	15	60
Freeport	27.0	72,900,000		30,982,500	50	15	30
Total		438,480,000		288,917,550			

Coal resources in Greene County by townships—Continued.

Wayne Township — Area 41.0 square miles

Bed	Area (sq. mi.)	Original deposit	Mined out and lost	Recoverable	Mining per cent	Mining loss per cent	Range of thickness (inches)
Pittsburgh	41.0	275,580,000		199,106,550	85	15	68-84
Sewickley	41.0	137,592,000		99,410,220	85	15	20-68
Waynesburg	41.0	208,125,000		141,525,000	80	15	45-80
Freeport	41.0	110,700,000		47,047,500	50	15	30
Total		731,997,000		487,089,270			

Whiteley Township — Area 32.9 square miles

Bed	Area (sq. mi.)	Original deposit	Mined out and lost	Recoverable	Mining per cent	Mining loss per cent	Range of thickness (inches)
Pittsburgh	32.9	235,008,000		179,781,120	90	15	72-88
Sewickley	32.9	78,210,000		59,830,650	90	15	20-40
Waynesburg	32.9	177,660,000		120,808,800	80	15	60
Freeport	32.9	88,830,000		37,752,750	50	15	30
Total		579,708,000		398,173,320			

COAL ANALYSES

The analyses in the following table are arranged alphabetically by geographic location. They were made by fuel chemists of the United States Bureau of Mines[1] at the Pittsburgh Experiment Station. The samples were collected by Mr. L. D. Woodworth, Carnegie Institute of Technology, in January and February, 1922 for the Pennsylvania Topographic and Geologic Survey. The methods[2] of sampling and analysis used are those employed by the U. S. Geological Survey and Bureau of Mines.

The analyses are grouped as follows:

1. The proximate analysis—moisture, volatile matter, fixed carbon, and ash.
2. The ultimate analysis—carbon, hydrogen, nitrogen, oxygen, sulphur, and ash.
3. The calorific value of heat of combustion.
4. The softening temperature of ash, when such determinations were made.

Ultimate analyses are given in three conditions—namely, (1) as received; (2) moisture free; and (3) moisture and ash free. Proximate analyses and heating values are given in two conditions—namely, as received, and moisture free.

The as-received condition represents the sample as received at the laboratory, while the moisture-free condition represents the composition and heating value of the dry coal. The moisture- and ash-free condition represents approximately the composition and calorific value of the dry combustible matter.

The analyses are given to the nearest 0.1 per cent, and the B. t. u. to the nearest 10, although the laboratory determinations are made to the nearest 0.01 per cent and the nearest unit B. t. u.

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[1] Bituminous coal fields of Pennsylvania—Coal analyses: Pa. Top. & Geol. Survey, 4th ser. Bull. M6 pt. IV. pp. 85-89, 1925.

[2] Stanton, F. M., and Fieldner, A. C., Methods of analyzing coal and coke: U. S. Bureau of Mines, Tech. Paper 8, 42 pp., 1913.

Analyses of Greene County mine samples.

Locality, mine, coal bed, etc.	Sample.			Proximate.				Ultimate.						Calorific value.		
	Laboratory No.*	Kind.†	Condition.‡	Moisture.	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Hydrogen.	Carbon.	Nitrogen.	Oxygen.	Air-drying loss.	Calories.	British thermal units.	Softening temp. °F.§
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Besco; William Pitt mine, Pittsburgh bed (face of 1 left butt, 2 north entry)	83,976	B	1	2.5	35.0	55.8	6.7	1.1	-----	------	-----	-----	1.7	7,607	13,690	2,240
Same (face of 1 north entry)	83,977	B	1	2.8	35.0	55.6	6.6	1.0	-----	------	-----	-----	2.0	7,633	13,740	2,240
Same (face of 2 right butt, 1 north entry)	83,978	B	1	2.5	34.8	55.6	7.1	1.3	-----	------	-----	-----	1.7	7,575	13,630	2,280
Same (right rib, main haulageway, 300 feet from mine mouth)	83,979	B	1	2.7	34.8	56.4	6.1	.8	-----	------	-----	-----	1.9	7,663	13,790	2,620
Same (composite of samples 83,976 to 83,979 inclusive)	83,980	B	1	2.6	34.9	55.8	6.7	1.2	5.3	77.0	1.6	8.2	1.8	7,621	13,720	-------
			2	-----	35.8	57.3	6.9	1.2	5.1	79.1	1.6	6.1	-----	7,824	14,090	-------
			3	-----	38.5	61.5	------	1.3	5.5	85.0	1.7	6.5	-----	8,404	15,130	-------
Clarksville, ½ mile west of; Edward mine, Pittsburgh bed (face of main rise)	83,846	B	1	3.0	33.3	55.7	8.0	1.3	-----	------	-----	-----	2.1	7,479	13,460	2,310
Same (ace of 1 right butt entry)	83,847	B	1	3.0	34.7	56.5	5.8	1.0	-----	------	-----	-----	2.1	7,691	13,840	2,390
Same (left rib, main air shaft entry, 200 feet from shaft)	83,848	B	1	3.6	33.0	55.0	8.4	1.5	-----	------	-----	-----	2.6	7,397	13,320	2,340
Same (composite of samples 83,846 to 83,848 inclusive)	83,849	B	1	3.1	33.7	55.8	7.4	1.3	5.2	76.0	1.6	8.5	2.2	7,503	13,510	-------
			2	-----	34.8	57.6	7.6	1.3	5.1	78.4	1.7	5.9	-----	7,743	13,940	-------
			3	-----	37.7	62.3	------	1.4	5.5	84.8	1.8	6.5	-----	8,380	15,090	-------
Crucible; Crucible mine, Pittsburgh bed (face of main heading)	84,169	B	1	2.6	34.5	55.7	7.2	2.1	-----	------	-----	-----	1.8	7,580	13,640	2,220
Same (face of 1 west flat entry, 3 main right entry)	84,170	B	1	2.2	34.7	55.8	7.3	1.2	-----	------	-----	-----	1.3	7,632	13,730	2,390
Same (face of 1 east entry, 2 section, 2 main left entry)	84,171	B	1	1.9	35.9	55.5	6.7	1.0	-----	------	-----	-----	1.1	7,717	13,890	2,620
Same (face of 2 east flat entry, 2 section, 2 main left entry)	84,172	B	1	1.7	34.6	54.8	8.9	1.3	-----	------	-----	-----	1.2	7,555	13,600	2,620
Same (face of 3 east entry, 2 section, 2 main left entry)	84,173	B	1	2.6	34.7	53.6	9.1	1.9	-----	------	-----	-----	1.8	7,412	13,340	2,390
Same (face of 3 flat entry, 1 section, 1 main left entry)	84,174	B	1	2.1	35.1	54.7	8.1	2.0	-----	------	-----	-----	1.3	7,541	13,580	2,160
Same (composite of samples 84,169 to 84,174 inclusive)	84,175	B	1	2.1	35.1	55.7	7.7	1.5	5.2	76.1	1.6	7.9	1.4	7,591	13,670	-------
			2	-----	35.9	56.2	7.9	1.6	4.5	77.7	1.7	6.6	-----	7,762	13,970	-------
			3	-----	38.9	61.1	------	1.7	4.9	84.4	1.8	7.2	-----	8,420	15,160	-------
Durbin; Crabapple mine, Waynesburg bed	1,585	B	1	2.8	36.1	48.3	12.8	3.5	-----	------	-----	-----	1.2	------	------	-------
			2	-----	37.1	49.7	13.2	3.6	-----	------	-----	-----	-----	------	------	-------

Analyses of Greene County mine samples—Continued.

Locality, mine, coal bed, etc.	Sample.			Proximate.				Ultimate.					Air-drying loss.	Calorific value.		Softening temp. °F.§
	Laboratory No.*	Kind.†	Condition.‡	Moisture.	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Hydrogen.	Carbon.	Nitrogen.	Oxygen.		Calories.	British thermal units.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Grays Landing, ½ mile south of; Alicia No. 2 mine, Pittsburgh bed (face of 21 right butt entry, 3 left entry)	84,203	B	1	1.9	34.2	53.1	10.8	2.5	-----	-----	-----	-----	1.5	7,365	13,260	2,240
Same (face of 12 face entry, 4 left entry)	84,204	B	1	2.1	35.4	55.5	7.0	2.0	-----	-----	-----	-----	1.6	7,611	13,700	2,200
Same (left rib of 5 left entry, 400 feet from main entry)																
Same (right rib of 4 right entry, 4,000 feet from main entry)	84,206	B	1	2.5	33.7	55.6	8.2	2.5	-----	-----	-----	-----	1.9	7,529	13,550	2,170
Same (face of 5 room, 1 butt entry, 3 right entry)	84,207	B	1	1.9	34.4	56.7	7.0	2.0	-----	-----	-----	-----	1.5	7,659	13,790	2,510
Same (composite of samples 84,203 to 84,207 inclusive)	84,208	B	1	2.0	34.6	55.1	8.3	2.4	5.2	75.8	1.6	6.7	1.6	7,575	13,640	-----
			2	-----	35.3	56.3	8.4	2.4	5.0	77.4	1.6	5.2	-----	7,733	13,920	-----
			3	-----	38.6	61.4	-----	2.6	5.5	84.5	1.7	5.7	-----	8,446	15,200	-----
Drift mine (near Alicia No. 2 mine), Sewickley bed (left rib, 3 left entry, main entry 1,300 feet from mine mouth)	84,246	B	1	2.2	34.3	51.8	11.7	3.0	-----	-----	-----	-----	1.9	7,148	12,860	2,230
Same (face of main heading)	84,247	B	1	2.4	35.1	52.6	9.9	2.9	-----	-----	-----	-----	2.2	7,259	13,070	2,280
Same (composite of samples 84,246 and 84,247)	84,248	B	1	2.3	35.0	51.9	10.8	2.9	5.1	71.7	1.5	8.0	2.1	7,198	12,950	-----
			2	-----	35.9	53.0	11.1	3.0	4.9	73.5	1.6	5.9	-----	7,372	13,270	-----
			3	-----	40.4	59.6	-----	3.4	5.5	82.6	1.7	6.8	-----	8,289	14,920	-----
Jefferson; Fulton country bank, Waynesburg bed (at face, 50 feet from mine mouth)	83,751	B	1	3.2	34.0	49.9	12.9	3.1	-----	-----	-----	-----	2.5	6,950	12,510	-----
			2	-----	35.1	51.6	13.3	3.2	-----	-----	-----	-----	-----	7,178	12,920	-----
¾ mile north of; Rogers country bank, Waynesburg bed (at face, 300 feet from mine mouth, upper bench)	83,752	B	1	3.1	36.2	46.3	14.4	3.8	-----	-----	-----	-----	2.6	6,822	12,280	-----
			2	-----	37.3	47.9	14.8	3.9	-----	-----	-----	-----	-----	7,038	12,670	-----
Same (lower bench)	83,753	B	1	3.9	34.4	50.0	11.7	3.0	-----	-----	-----	-----	3.2	7,011	12,620	-----
			2	-----	35.8	52.0	12.2	3.1	-----	-----	-----	-----	-----	7,294	13,130	-----
Mather; Mather No. 1 mine, Pittsburgh bed (face of 2 south face heading)	83,771	B	1	3.7	35.1	55.7	5.5	.8	-----	-----	-----	-----	2.9	7,617	13,710	2,450
Same (face of 5 south face heading)	83,772	B	1	2.5	35.6	55.8	6.1	1.0	-----	-----	-----	-----	1.7	7,673	13,810	2,340
Same (face of 10 south face heading)	83,773	B	1	3.0	35.1	55.9	6.0	1.0	-----	-----	-----	-----	2.2	7,639	13,750	2,280
Same (face of 3 main north butt heading)	83,774	B	1	2.3	36.2	57.3	4.2	.8	-----	-----	-----	-----	1.5	7,852	14,140	2,390
Same (face of 5 main north face heading)	83,775	B	1	3.5	34.6	55.9	6.0	1.3	-----	-----	-----	-----	2.7	7,600	13,680	2.450

Same (face of 9 butt heading, 2 main heading)	83,776	B	1	2.7	34.5	56.7	6.1	1.0	----	----	----	----	1.9	7,684	13,830	2,450
Same (composite of samples 83,771 to 83,776 inclusive)	83,777	B	1	3.0	35.2	55.9	5.9	1.0	5.3	77.7	1.7	8.4	2.2	7,671	13,810	----
			2	----	36.3	57.6	6.1	1.0	5.2	80.1	1.8	5.8	----	7,908	14,240	----
			3	----	38.7	61.3	----	1.1	5.5	85.3	1.9	6.2	----	8,422	15,170	----
Nemacolin; Nemacolin mine, Pittsburgh bed (face of drainage heading, north river flat section)	84,162	B	1	2.7	33.3	56.3	7.7	1.0	----	----	----	----	1.9	7,583	13,650	2,540
Same (face of 7 road, north river flat section)	84,163	B	1	2.3	33.7	56.9	7.1	1.0	----	----	----	----	1.5	7,677	13,820	2,620
Same (face of 10 road, north river flat section)	84,164	B	1	2.4	34.1	56.4	7.1	1.0	----	----	----	----	1.6	7,689	13,840	2,220
Same (face of 305 road, south flat section)	84,165	B	1	2.1	35.2	56.4	6.3	1.1	----	----	----	----	1.3	7,754	13,960	2,340
Same (face of 313 road, 1 south flat section)	84,166	B	1	2.2	33.5	57.2	7.1	1.6	----	----	----	----	1.4	7,681	13,830	2,240
Same (left rib, 309 parallel road, 300 feet from 1 south flat section)	84,167	B	1	1.9	35.1	56.8	6.2	1.1	----	----	----	----	1.1	7,782	14,010	2,260
Same (composite of samples 84,162 to 84,167 inclusive)	84,168	B	1	2.2	34.0	57.0	6.8	1.2	5.2	77.5	1.6	7.7	1.5	7,698	13,860	----
			2	----	34.8	58.3	6.9	1.2	5.2	79.3	1.6	5.8	----	7,874	14,170	----
			3	----	37.4	62.6	----	1.3	5.5	85.2	1.8	6.2	----	8,461	15,230	----
Point Marion, ½ mile southwest of; Jeannette mine, Pittsburgh bed (face of 2 right entry, main heading)	84,475	B	1	2.8	36.0	53.8	7.4	2.7	----	----	----	----	2.2	7,583	13,650	2,202
Same (face of 4 room, 150 feet to the right, from face of main heading)	84,476	B	1	2.9	35.6	53.1	8.4	3.2	----	----	----	----	2.3	7,491	134,80	2.280
Same (face of 9 room, to left of main parallel entry)	84,477	B	1	2.8	35.5	54.8	6.9	2.6	----	----	----	----	2.2	7,625	13,720	2 280
Same (composite of samples 84,475 to 84,477 inclusive)	84,478	B	1	2.9	35.9	53.9	7.3	2.7	5.3	75.7	1.5	7.5	2.3	7,551	13,590	----
			2	----	36.9	55.6	7.5	2.8	5.1	78.0	1.6	5.0	----	7,773	13,990	----
			3	----	39.9	60.1	----	3.0	5.5	84.3	1.7	5.5	----	8,402	15,130	----
Poland Station, ½ mile south of; Dunkard No. 1 mine, Sewickley bed (left rib, 2 right entry, 200 feet from main entry)	84,521	B	1	3.3	34.0	54.3	8.4	1.4	----	----	----	----	2.6	7,364	13,270	2,150
Same (right rib, 2 right entry, 750 feet from main entry)	84,522	B	1	2.8	35.4	53.7	8.1	1.8	----	----	----	----	2.4	7,468	13,440	2,130
Same (composite of samples 84,521 and 84,522)	84,523	B	1	3.1	34.4	54.3	8.2	1.6	5.1	74.2	1.6	9.3	2.5	7,406	13,330	----
			2	----	35.5	56.1	8.4	1.6	5.0	76.6	1.6	6.8	----	7,643	13,607	----
			3	----	38.7	61.3	----	1.8	5.5	83.7	1.8	7.2	----	8,347	15,020	----
Dunkard No. 2 mine, Pittsburgh bed (face of 7 right butt heading)	84,524	B	1	3.2	36.4	53.4	7.0	2.9	----	----	----	----	3.0	7,585	13,660	2,280
Same (face of 9 room, 5 right butt heading)	84,525	B.	1	3.3	36.3	52.2	8.2	3.2	----	----	----	----	2.8	7,486	13,470	2,280
Same (face of 3 left butt heading)	84,526	B	1	2.7	37.0	53.7	6.6	2.7	----	----	----	----	2.3	7,643	13,760	2,280
Same (right rib, 3 right butt heading, 1,000 feet from main heading)	84,527	B	1	2.9	36.3	53.2	7.6	3.0	----	----	----	----	2.5	7,558	13,600	2,230
Same (composite of samples 84,524 to 84,527 inclusive)	84,528	B	1	3.0	36.9	52.8	7.3	2.9	5.4	74.9	1.4	8.1	2.6	7,541	13,570	----
			2	----	38.1	54.4	7.5	3.0	5.3	77.2	1.4	5.6	----	7,776	14,000	----
			3	----	41.2	58.8	----	3.3	5.7	83.5	1.5	6.0	----	8,409	15,140	----
½ mile north of; Poland No. 3 mine, Pittsburgh bed (face of 1 room, 3 left butt, 8 right flat section)	84,428	B	1	1.8	35.0	55.8	7.4	1.8	----	----	----	----	1.4	7,655	13,780	2,150
Same (face of 9 right flat entry)	84,429	B	1	1.8	36.2	55.6	6.4	2.1	----	----	----	----	1.4	7,738	13,930	2,180
Same (face of 4 main heading)	84,430	B	1	2.9	36.4	52.9	7.8	2.3	----	----	----	----	2.5	7,517	13,530	2,110
Same (face of 9 left flat entry)	84,431	B	1	2.0	36.3	53.5	8.2	3.1	----	----	----	----	1.6	7,586	13,650	2,130
Same (left rib, 7 left flat entry, 50 feet from face)	84,432	B	1	2.5	35.9	54.9	6.7	2.4	----	----	----	----	2.0	7,660	13,790	2 110
Same (composite of samples 84,428 to 84,432 inclusive)	84,433	B	1	2.2	35.9	54.6	7.3	2.4	5.3	76.6	1.6	6.8	1.8	7,620	13,720	----
			2	----	36.7	55.8	7.5	2.5	5.2	78.3	1.6	4.9	----	7,794	14,030	----
			3	----	39.7	60.3	----	2.7	5.6	84.6	1.7	5.4	----	8,423	15,160	----

*, †, ‡, §, See footnote Page

Analyses of Greene County mine samples—Concluded.

Locality, mine, coal bed, etc.	Sample.			Proximate.				Ultimate.					Air-drying loss.	Calorific value.		Softening temp. °F.§
	Laboratory No.*	Kind.†	Condition.‡	Moisture.	Volatile matter.	Fixed carbon.	Ash.	Sulphur.	Hydrogen.	Carbon.	Nitrogen.	Oxygen.		Calories.	British thermal units.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
½ mile northwest of; Rosedale No. 2 mine, Sewickley bed (face of main dip heading)	84,479	B	1	2.5	34.0	55.3	8.2	1.3	----	----	----	----	1.9	7,450	13,410	2,620
Same (face of 7 left face heading)	84,480	B	1	2.4	36.0	53.6	8.0	2.3	----	----	----	----	1.8	7,526	13,550	2,220
Same (face of 3 right face heading)	84,481	B	1	3.1	36.4	51.7	8.8	3.0	----	----	----	----	2.5	7,401	13,320	2,220
Same (composite of samples 84,479 to 84,481 inclusive)	84,482	B	1	2.7	35.3	54.0	8.0	2.1	5.2	74.6	1.6	8.5	2.1	7,449	13,410	----
			2	----	36.2	55.6	8.2	2.1	5.1	76.6	1.6	6.4	----	7,647	13,760	----
			3	----	39.5	60.5	----	2.3	5.5	83.6	1.8	6.8	----	8,340	15,010	----
Rices Landing; Dilworth mine, Pittsburgh bed (face 9 left butt heading, 2 north entry)	83,892	B	1	2.1	36.2	53.1	8.6	2.4	----	----	----	----	1.3	7,534	13,560	2,170
Same (face of 5 room, 10 right butt heading)	83,893	B	1	2.7	35.0	53.4	8.9	2.3	----	----	----	----	1.9	7,439	13,390	2,150
Same (face of 10 right butt heading)	83,894	B	1	3.4	34.3	52.6	9.7	2.3	----	----	----	----	2.7	7,300	13,140	2,150
Same (face of 2 south heading)	83,895	B	1	3.3	33.3	53.1	10.3	1.4	----	----	----	----	2.6	7,246	13,040	2,150
Same (face of straight main heading)	83,896	B	1	3.4	34.2	54.4	8.0	1.4	----	----	----	----	2.7	7,465	13,440	2,370
Same (composite of samples 83,892 to 83,896 inclusive)	83,897	B	1	2.9	34.5	53.6	9.0	1.9	5.2	74.8	1.6	7.5	2.2	7,417	13,350	----
			2	----	35.5	55.2	9.3	2.0	5.0	77.0	1.6	5.1	----	7,639	13,750	----
			3	----	39.1	60.9	----	2.2	5.5	84.9	1.8	5.6	----	8,422	15,160	----
½ mile west of; Hoge country bank, Waynesburg bed (at face, 75 feet northwest of mine mouth)	84,052	B	1	3.3	33.0	47.0	16.7	3.5	----	----	----	----	2.5	6,619	11,910	2,240
			2	----	34.2	48.6	17.2	3.6	----	----	----	----	----	6,847	12,320	----
Ryerson Station; Country bank, Washington bed (lower bench)	1,239	B	1	2.2	36.8	47.0	14.0	3.8	----	----	----	----	----	----	----	----
			2	----	37.6	48.0	14.4	3.9	----	----	----	----	----	----	----	----
Waynesburg, 2 miles southeast of; Guthrie mine, Waynesburg bed (right rib, 1 right entry, at air-break, 175 feet from outcrop)	83,811	B	1	4.2	32.8	47.0	16.0	1.9	----	----	----	----	2.4	6,615	11,910	2,450
Same (face of 3 left entry, main heading)	83,812	B	1	3.2	33.4	44.9	18.5	3.1	----	----	----	----	2.1	6,434	11,580	2,570
Same (composite of samples 83,811 and 83,812)	83,813	B	1	3.4	32.8	46.7	17.1	2.4	4.9	65.4	1.4	8.8	2.3	6,529	11,750	----
			2	----	34.0	48.3	17.7	2.5	4.7	67.7	1.4	6.0	----	6,759	12,160	----
			3	----	41.3	58.7	----	3.0	5.7	82.3	1.7	7.3	----	8,213	14,780	----

2 miles southeast of; Moredock mine, Waynesburg bed (face of 1 left entry)	83,814	B	1	3.2	33.5	45.7	17.6	3.7	-----	------	-----	-----	2.2	6,510	11,720	2,390
Same (face of 10 room, left of main heading)	83,815	B	1	3.4	34.1	46.9	15.6	3.2	-----	------	-----	-----	2.4	6,686	12,020	2,450
Same (composite of samples 83,814 and 83,815)	83,816	B	1	3.3	33.5	46.7	16.5	3.3	4.9	65.8	1.3	8.2	2.3	6,611	11,900	-------
			2	-----	34.6	48.3	17.1	3.4	4.7	68.0	1.3	5.5	-----	6,837	12,310	-------
			3	-----	41.7	58.3	------	4.1	5.7	82.0	1.6	6.6	-----	8,247	14,850	-------
4 miles east of; Pratt Hill mine, Waynesburg bed (face of 1 left entry)	83,782	B	1	3.4	33.7	49.8	13.1	1.8	-----	------	-----	-----	2.1	6,896	12,410	2,680
			2	-----	34.9	51.5	13.6	1.9	-----	------	-----	-----	-----	7,139	12,850	-------

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* Laboratory numbers with prefix W represent samples analyzed in the Washington laboratory of the U. S. Bureau of Mines: all others were analyzed at the Pittsburgh laboratory.

† A, mine samples collected by an engineer of the U. S. Bureau of Mines; B, mine sample collected by a geologist of either the U. S. Geological Survey or the Pennsylvania Topographic and Geologic Survey.

‡ 1. sample "as received" at the laboratory; 2, dried at a temperature of 105° C.: 3, moisture and ash free.

§ Figures in column 17 are the temperatures at which the cone of coal ash has fused down to a spherical lump when heated in the furnace in a slightly reducing atmosphere.

OWNERSHIP OF COAL LAND IN GREENE COUNTY.

By B. F. Hoffacker

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With the exception of a small area in the southeast corner and a still smaller area in the northeast corner, the entire county is underlain by the Pittsburgh coal bed. Approximately 98 per cent of the county originally contained this valuable bed; and even though mining operations have been carried on for more than twenty years, only 1 per cent has been mined out up to January 1, 1928. From a standpoint of remaining area, Greene County is second only to Washington County, with approximately 358,000 acres unmined as of this date. Greene County's area of Pittsburgh coal is approximately 40 per cent of the total area in the State.

Although the presence of this great bed of coal was known for years through outcrop within and without the county and from the records of numerous wells drilled for oil and gas, it was not until shortly before 1890 that any attempt was made to sever the coal from the surface through purchases. Having always been an agricultural county, the land owners sold their holdings in fee, possibly with reservations of oil and gas rights in a few cases.

During the early nineties a buying campaign was started by J. V. Thompson, Geo. L. Hibbs, L. W., T. B., and F. W. Semans, J. M. Husted, and J. R. and J. E. Barnes, all of Uniontown, Pa. Between 1893 and 1899, they purchased some 70,000 acres for their joint account, and several thousand additional acres were purchased by speculators attracted to the county by these large purchases. Prices ranged from $25 to $50 per acre for coal in the eastern half of the county, while as low as $5 per acre was paid for coal west of Waynesburg.

In a few years this coal land was sold for prices which showed tremendous profits on the original investments. In many cases a few dollars per acre comprised the initial payment, notes being given for the balance; and the sudden enhancement in value made it possible for the purchasers to borrow on their equity to make additional purchases before the notes became due.

Between 1900 and 1909 coal purchased for as little as $20 per acre less than ten years previous was sold for as much as $600 per acre. Prior to the business depression in 1907, speculation was at a fever heat. The coal and coke companies and the various steel companies were appearing on the scene and investing in large blocks of coal. By the end of 1907 approximately 80 per cent of the coal in the county had passed from the hands of the original owners. In Gilmore Township only was most of the coal still in the hands of owners of the surface. From 1907 to 1914 the principal sales were made by J. V. Thompson and his associates. They controlled, in 1907, more than 120,000 acres. Between 1907 and 1914 they sold over 40,000 acres; and when the First National Bank at Uniontown closed, in January 1915, they still controlled over 116,000 acres. With the knowledge that all this coal would eventually be thrown on the market, there was a marked lull in sales of coal land. The great demand for coal occasioned by the World War, however, soon caused a different feeling and much of this coal controlled by Thompson was purchased by the U. S. Steel Corporation, Jones & Laughlin Steel Company, and others. One of the last sales made in the county was that of the Youghiogheny & Ohio Coal Company to the Rainey-Wood interests. This block of 2,600 acres was purchased from the land owners in 1900 at $20 per acre and sold by the writer in 1920 for $3,000,000.

In 1928 there is little coal land for sale in the eastern half of the county, but in the western half practically all is for sale at prices from $50 to $400 per acre. In the western half of the county large blocks of coal land were bought over twenty years ago, and are held now by either the original purchasers, their heirs, or by others who have purchased undivided interests in the blocks. No changes have been made in the size or shape of the holdings. In some of the blocks the number of interests have multiplied many times, through the deaths of original purchasers and the resultant ownership by heirs and estates.

In the southeastern portion of Greene County, the Sewickley coal has become an important factor in the last ten years, from the standpoint of both production and value. Six companies are mining this coal; and recently prices have gone as high as $500 per acre for individual pieces. The purchasers of the underlying Pittsburgh bed could, in almost every instance, have obtained possession of the Sewickley bed by simply leaving out the word "Pittsburgh" or "River Vein" in their deeds, and having them read "All the coal" instead. This was not done, however, and the result was a consequent windfall to those who sold their Pittsburgh coal at a low price. Even areas of the Waynesburg coal were sold during the World War, and several operations started, but they have now all been abandoned.

The present ownership of Pittsburgh coal in Greene County may be divided into four classes: (1) Coal held by companies, the output from which is now, or will be consumed entirely by those companies, and termed "Captive Coal;" (2) Coal owned by companies, the output from which is now or will be sold to the general trade; (3) Coal owned by companies, individuals, or groups of individuals, and held for purely speculative purposes; and (4) Coal still in the original owner's hands, or which has never been severed from the surface.

In Greene County 111,000 acres of captive coal are held as follows:

Coal owned by:	Output used by:	Acres
H. C. Frick Coke Co. (Cumberland Coal Co.)	U. S. Steel Corporation	70,000
Shannopin Coal Company	Jones & Laughlin Steel Corp.	13,500
Buckeye Coal Company	Youngstown Sheet & Tube Co.	8,100
Crucible Fuel Company	Crucible Steel Company	4,200
Monessen Coal & Coke Co.	Pittsburgh Steel Company	2,000
W. J. Rainey, Inc.	Rainey-Wood Company	2,600
Mather Collieries Co.	Steel Company of Canada Pickands-Mather Perry Iron Works	4,100
Bethlehem Mines Corp.	Bethlehem Steel Corp.	4,000
Graceton Coke Company	Youngstown Interests	1,500
Penn Pitt Coal Company	Donner Steel Company	1,000
		111,000

Seven of these concerns are engaged in mining operations and have a total daily output of approximately 20,000 tons. They include all of the above, except W. J. Rainey, Inc., Bethlehem Mines Corporation, and Graceton Coke Company.

In the second group or commercial operators are the following concerns, together with their acreage:

Name	Acreage
Youghiogheny & Ohio Coal Co.	10,000
Emerald Coal & Coke Company	10,000
J. H. Hillman Interests	4,000
Chartiers Southern Coal Co.	600
Poland Coal Company	500
Moffett-Sterling Gas Coal Co.	350
West Point Marion Coal Co.	250
Mapel-Sterling Coal Co.	100
	25,800

All of these are operating except the Youghiogheny & Ohio Coal Company and the Emerald Coal & Coke Company.

In the third group, which is the largest in point of acreage held, are the following:

Name	Acreage
A. W. Mellon	76,000
Piedmont Coal Company and Associates	17,500
St. Paul Coal Company	10,000
Rutan Coal & Coke Co.	6,000
M. H. Bowman et al.	5,700
Smith Creek Block	5,000
Hargus Creek Coal & Coke Company	5,000
Morris Township Coal & Coke Company	4,500
Hibbs Estate et al.	3,800
Keystone Coal Company	3,400
Greene County Coal Co.	3,500
E. H. Jennings	3,000
G. W. Gallagher	2,300
T. B. Semans et al.	2,100
J. A. Phillips Estate	2,100
Rowe Estate	2,000
Nettle Hill Block	1,800
Dunkard Creek Coal Co.	1,800
Swartz Field	1,800
R. D. Warman et al.	1,600
J. T. Robison et al.	1,500
James L. Rush et al.	1,400
Eli Eichelberger	1,250
W. F. Kaiser et al.	1,200
F. P. Lilley et al.	1,100
Brownfield Coal & Coke Company	1,000
Wm. Finley et al.	1,000
B. F. Sterling et al.	850
Mestrezat Estate	1,000
	169,200

Smaller holdings in the third group are not listed.

Of the Sewickley coal in the vicinity of Greensboro, the W. H. Donner interests, through the Penn Pitt Coal & Coke Company, are the largest owners; this company and the Fredericktown Coal & Coke Company are the principal operators of this coal. No commercial mines are operating the Waynesburg bed. All mining in this coal is for local use only.

The present status of Greene County coal ownership is more clearly seen on the accompanying map, which shows the extent of the holdings as of January 1, 1928.

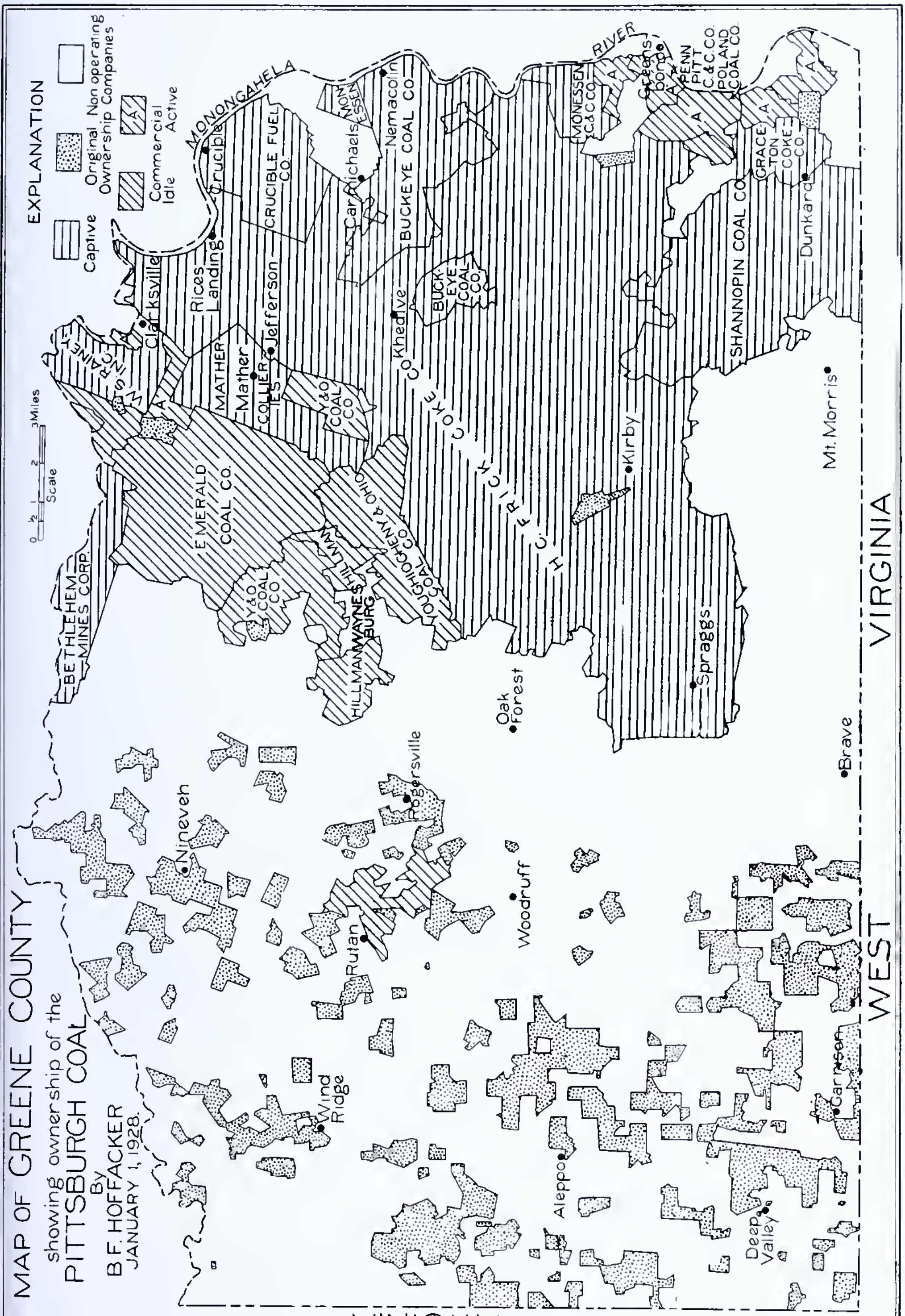

Fig. 35. Ownership of Pittsburgh coal land in Greene County.

OIL AND GAS SANDS.

INTRODUCTION.

In western Pennsylvania all oil and gas yet discovered have been produced from beds of sandstone, or "sands," as they are called by the drillers. The beds penetrated have been given various designations from time to time, and these terms have gradually come into common usage as descriptive of the beds. In order to show their general relations the following table has been prepared, giving the drillers' terms, the corresponding geologic terms, and the formation to which the sands belong:

Drillers' terms for oil and gas rocks, etc., and their geologic correlation.

Group	Name applied by drillers	Geologic name	Approximate maximum thickness
			Feet
Washington	Washington coal	Washington coal	3
	Bluff sand	Waynesburg sandstone	60
Monogahela	Waynesburg coal	Waynesburg coal	5
	Mapletown coal	Sewickley coal	8
	Pittsburgh coal	Pittsburgh coal	10
Conemaugh	Murphy sand	Morgantown sandstone	30
	Little Dunkard sand	Saltsburg sandstone	100
	Big Dunkard or Hurry-up sand	Mahoning sandstone	150
	Upper Freeport or Connellsville		
Allegheny	U. F. coal	Kittanning, Clarion	150
	Gas sand	Conoquenessing or 200?	
Pottsville	Salt sand	Pottsville sandstone	200?
Mauch Chunk	Red rock or shale	Mauch Chunk shale	150
	Salvaton (Maxton) sand		
	Little lime (or Salvaton sand)	Greenbrier limestone	100
	Pencil cave		
	Big lime		
Pocono	Big Injun sand	Burgoon sandstone	300
	Thirty-foot sand	Berea sandstone	100
	Gantz sand		40
	Fifty-foot sand		60
Devonian	Nineveh or Nineveh thirty-foot sand		40
	Red rock		20
	Gordon Stray sand		40
	Gordon sand		100
	Fourth sand		40
	Fifth sand		40
	Bayard sand		12
	Elizabeth sand		10

Oil and gas are found in Greene County in paying quantities at several horizons. The oil sands are the Dunkard, Big Injun, Gantz, Fifty-foot, Nineveh, Gordon, and Fourth. The important gas sands include those just given and, in addition, the Salt, Fifth, Bayard, and Elizabeth sands. In using the driller's designations of the various beds, it is not supposed that all of them are in reality continuous sandstone beds underlying the entire area. That is true of a few beds such as the Big Injun and Salt sand, but if the extent of the others is anything like that of sandstone beds covering large areas of the surface in western Pennsylvania, they are generally lentils in the formation rather than distinct beds by themselves.

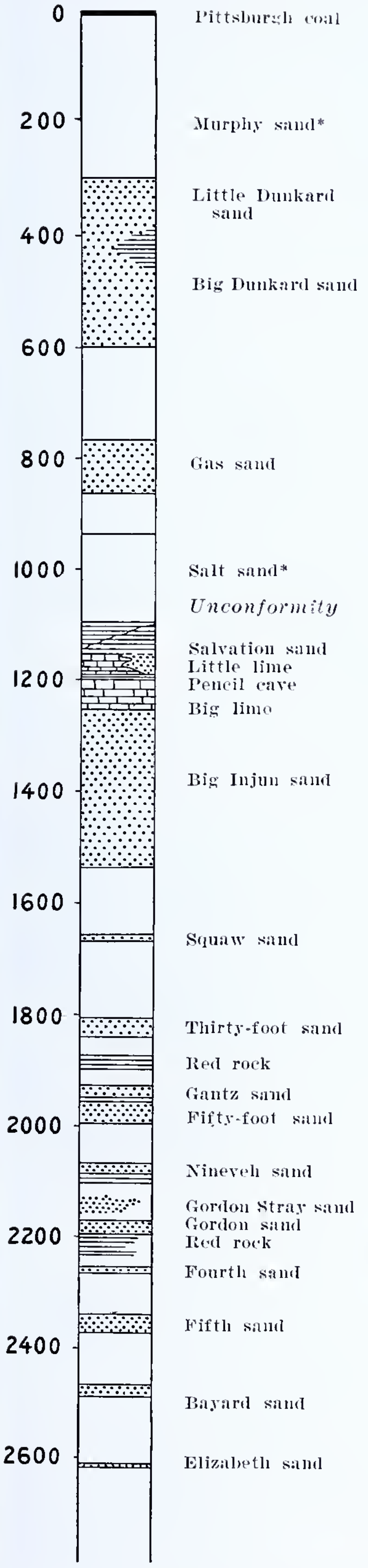

Fig. 36. Columnar section of sands below Pittsburgh coal.

* Sand pattern by error omitted from figure

The position of the sands is referred to the Pittsburgh coal as it underlies the entire region.

The following table shows the distances from the Pittsburgh coal to the top of the well-known sands.

Distances from Pittsburgh coal to principal gas sands in Greene County.

Sand	Maximum	Minimum	Average
	Ft.	Ft.	Ft.
Murphy	232	170	211
Dunkard	575	390	478
Gas	856	674	765
Salt	1,035	860	932
Big Injun	1,345	1,073	1,222
Berea, Thirty-foot	1.882	1,729	1,916
Gantz	1,965	1,813	1,916
Fifty-foot	2.044	1,902	1,937
Nineveh	2,121	1,997	2,051
Gordon	2 227	2 070	2,157
Fourth	2,298	2.140	2,230
Fifth	2.365	2,225	2,292
Bayard	2,464	2,388	2,433
Elizabeth			2,605

MURPHY SAND.

In the western half of the county a sandstone called the Murphy sand is frequently reported by drillers. It generally occurs from 170 to 200 feet below the Pittsburgh coal, but in Springhill Township the distance is as much as 220 feet. This sand runs from 5 to 30 feet in thickness and in exceptional cases reaches 70 feet. It corresponds approximately in stratigraphic position with a prominent surface sandstone known in southwestern Pennsylvania and northern West Virginia as the Morgantown sandstone, from the city of Morgantown, W. Va.

DUNKARD SAND.

According to identifications by various drillers in different parts of the county, the Dunkard sand lies from 300 to 575 feet below the Pittsburgh coal, and its thickness ranges from 40 to 150 feet. In the eastern part of the county some drillers find a small break in this sandstone, and in the western part it consists of two quite distinct beds, the upper and lower divisions being known as the Little and Big Dunkard sands. The name is taken from Dunkard Creek, near the mouth of which some producing oil wells were struck in this sand about 1863. The wells at Willow Tree and in the Garrison oil field, 2 miles south of Willow Tree, are producing oil from the Dunkard sand. In other areas this sand is generally unproductive, although in several townships it has shown traces of oil or gas. In the western part of the county the Big Dunkard is frequently called the Hurry-up sand.

GAS SAND.

The Gas sand is not important, but several wells produce gas from it in the Richhill field, between Durbin and Owens Run. In some places it holds considerable salt water. The position of this sand varies, according to different well records, and it is possible that there are a number of sandstones at this horizon, any one of which may be called the Gas sand. The average depth below the Pittsburgh coal is about 765 feet.

This sandstone may be regarded as the Homewood, the uppermost member of the Pottsville group, or as the Clarion, at the base of the Allegheny group. Its recorded thickness ranges from 15 to 140 feet, the variations being due in part to undoubted changes in the amount of sandstone present at this horizon and in part to a tendency on the part of the driller to class everything as sandstone for a considerable distance, when in reality it may be much broken by shale beds.

SALT SAND.

The Salt sand is so named because salt water is often encountered in drilling through it. In the Richhill field and in several wells on the crest of the Littleton anticline south of Deep Valley it produces considerable gas, and smaller quantities are occasionally found in it elsewhere in the county.

This sand is about 930 feet below the Pittsburgh coal, and, according to the records in hand, varies in thickness from 15 to 175 feet. It should be noted that in Greene County the Salt sand lies above the Big Injun sand, while in Armstrong County the same name is used for a gas-bearing stratum below the Big Injun.

Those records which give a thickness of over 100 feet for either the Gas or the Salt sand omit mention of the other, which shows that possibly both sands, being but little separated, have been included under one name.

The Salt sand is correlated with the Pottsville sandstone. Where the two principal members of the Pottsville are present, the upper member, the Homewood sandstone, may be called the First Salt Sand, and the Connoquenessing sandstone, the Second Salt Sand.

SALVATION (MAXTON) SAND.

The Salvation sand is equivalent to the Maxton sand of West Virginia. It is reported only in Aleppo, Cumberland, Franklin, Morris, Richhill and Springhill townships, where it lies above the Big Lime, separated from it by Little Lime and Pencil Cave. Elsewhere in the county this horizon seems to be represented by the Little Lime. The sand is generally unproductive, but a number of wells in Springhill

Township, on the Littleton anticline south of Deep Valley, produce gas from it. In a few well logs examined the thickness of this sand ranges from 8 to 93 feet.

BIG INJUN SAND.

The Big Injun sand rock is always recognized by the drillers from its thickness and position. It is usually from 250 to 300 feet thick, and, as shown by the records of hundreds of wells scattered through the county, lies at an average of about 1,220 feet below the Pittsburgh coal, ranging from 1,073 to 1,345 feet. In a general way the distance decreases northwestward from Dunkard and Perry townships to Richhill Township.

The average interval in the southeast quarter of the county is over 1,270 feet and in the northwest quarter less than 1,200 feet. This decrease in distance between the Pittsburgh coal and Big Injun sand is due to the thinning of the Mauch Chunk formation, as described in the chapter on stratigraphy.

The Big Injun sand is generally expected to carry some gas. It does so in Morgan, Franklin, Richhill, and Dunkard townships, and in the New Freeport field. In the Hoovers Run field and in scattering wells in Gilmore Township it ranks next to the Fifth sand as a gas producer. In the Mount Morris and Board Tree fields the Big Injun produces oil and, on the margins of some of the oil pools, gas.

SQUAW SAND.

An unproductive sand, usually less than 50 feet thick, is infrequently reported at distances varying from 50 to 150 feet below the base of the Big Injun. Wherever found it is known as the Squaw sand.

THIRTY-FOOT SAND.

The first sand commonly recognized below the Big Injun in Greene County is the Thirty-foot. Its distance below the Pittsburgh coal varies from 1,729 to 1,882 feet. So far as known, it does not produce oil or gas anywhere in this county, nor can it be recognized by its thickness, as in that particular the well records show wide variations. In this county the Thirty-foot sand is not the same as the Thirty-foot in Butler and Armstrong counties, but probably corresponds with what is sometimes known there as the Gas, Butler, or Murrysville sand. It agrees closely with the Berea sand of Beaver County, Pa., Jefferson County, Ohio, and Brooks County, W. Va. It is sometimes difficult to decide whether a sand noted as Thirty-foot in well records is in reality the Thirty-foot, Gantz, or some local sand, but this question can generally be answered by noting the positions of the red beds encountered by the drill. Between the Thirty-foot and Gantz sands lies a thin bed of red shale which is found in the wells of Washington County and generally in western Greene County, and which has been provisionally correlated with the Bedford shale of Ohio. The next lower red bed occurs 100 to 200 feet deeper, at the horizon of the Nineveh sand.

GANTZ SAND.

The Gantz sand is struck in the northern part of the county at distances varying from 1,870 to 1,946 feet below the Pittsurgh coal.

It takes its name from a well on the Gantz farm at Washington, which was drilled in 1885 and was the first paying oil well in Washington County. The sand was found 1,827 feet below the Pittsburgh coal, the interval being less than in Greene County because of the disappearance of the Mauch Chunk shale toward the northwest. The Gantz sand is usually 10 to 25 feet thick. It produces oil and some gas in the Fonner field in Morris Township and is the principal gas sand in the vicinity of Clarksville.

FIFTY-FOOT SAND.

A producing sand which closely underlies the Gantz sand and in many places merges with it is known as the Fifty-foot. Here and there the interval between them amounts to as much as 40 feet, but in the western half of the county the two sands run together and in that region are nearly always reported as the Fifty-foot. Frequently where the two sands are separated only by a thin shale they are recorded as continuous. These sands correspond in horizon with the Hundred-foot sand in Butler, Armstrong, Beaver, and other counties.

In view of the fact that the interval between the Pittsburgh coal and the Big Injun sand decreases from south to north, it is interesting to note that the interval between the top of the Big Injun and the top of the Fifty-foot increases in the same direction. This southward thinning of the rocks below the Mauch Chunk about compensates for the above-mentioned northward thinning.

NINEVEH SAND.

The Nineveh sand occurs from 60 to 150 feet below the top of the Fifty-foot sand. It may be either white or red and ranges from 10 to 40 feet in thickness. It is the principal producing sand of western Greene County. In the Nineveh, Grays Fork, Bristoria, and Springhill fields it is the principal oil sand and locally holds gas.

The Nineveh sand has been erroneously called the Gordon and sometimes the Gordon Stray over the greater portion of the Nineveh district, as explained in a paper by F. G. Clapp.[1] It takes its name from the village of Nineveh, in Morris Township, where it was first discovered to be productive. The sand is not reported in the eastern part of the county. Red rock, commonly found directly below this sand, aids in identifying it. It lies from 1,997 to 2,121 feet below the Pittsburgh coal.

GORDON STRAY SAND.

The Gordon Stray is a thin sand occurring in places a short distance above the true Gordon and at varying distances below the red rock associated with the Nineveh sand. The name has been often applied to the Nineveh, but such usage is obviously incorrect, as the Nineveh and Gordon sands are separated by red rock. The Gordon Stray seems to be the least definite of any of the commonly recognized sandstone beds; it may be either a split from the Gordon or a new sand. In the Delphene field and at a few isolated points elsewhere it produces gas. In the small Wright Run field, at several scattering points in the Bristoria field, and in one or two wells in the Board Tree field it produces oil.

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[1] Clapp, F. G., The Nineveh and Gordon oil sands of western Greene County, Pa.: U. S. Geol. Survey Bull. 285, pp. 362-366, 1906.

GORDON SAND.

The Gordon sand lies at an average distance of 2,159 feet below the Pittsburgh coal, or 200 feet below the top of the Fifty-foot sand, and is from 15 to 20 feet thick. In places it produces small amounts of gas and oil. The sand is usually recorded in wells which reach its depth.

As explained above, the term "Gordon" has been generally applied in western Greene County to the Nineveh sand, but such usage is incorrect. Also the Gordon has been erroneously called the "Fourth" sand by many drillers in the district. The Gordon is not generally productive in this area, but contains gas at a few wells in western Aleppo Township and in southeastern Center Township, one or two in the midst of the Bristoria field, and a number of wells in the Richhill, Hoovers Run, and Waynesburg fields. Oil is found in it in one or more wells in the Board Tree field, in one well on the southeastern edge of the Bristoria field, and in several wells on the western edge of the New Freeport field, in southern Aleppo Township.

FOURTH SAND.

Another sand which locally yields small amounts of gas or oil is the Fourth sand. It is reported at distances varying from 2,154 to 2,316 feet below the Pittsburgh coal and from 20 to 120 feet below the top of the Gordon sand. Its thickness ranges from 4 to 23 feet. The irregularity and occasional running together of the Gordon Stray, Gordon, and Fourth sands classes them as a group (the Gordon group) rather than as entirely distinct beds of sand.

In the Aleppo oil field the Fourth is the principal producing sand, and a number of wells have been drilled to it. Gas is produced from it at several wells on the borders of the New Freeport oil field, south of New Freeport and Deep Valley, and at some scattering wells in the Hoovers Run field and in Franklin, Jackson, and Richhill townships.

FIFTH SAND.

The great gas producers in Greene County are the Fifth and Bayard sands. Practically all wells in the eastern part of the county, except those in Dunkard, Greene, and Monongahela townships, are sunk to one or both of these beds. The Fifth sand lies from 2,225 to 2,365 feet below the Pittsburgh coal and ranges in thickness from 10 to 65 feet. It is known to some drillers as the McDonald sand, from the town of McDonald, Washington County. This sand yields some gas in the northern part of Morgan Township and in the Waynesburg field, and is the principal source on Pursley Creek and Hoovers Run. In the Hoovers Run field the Fifth sand occasionally goes by the name of Gas sand and in several instances has been called Gordon. In the Lantz field the Fifth sand yields oil from two pay streaks. Oil was found in this sand in one well at Waynesburg and also in the Aleppo field. Few of the wells in the western half of Greene County have gone deep enough to reach the Fifth sand, but it is known to yield gas in one well in Richhill Township and in two wells in northern Center Township.

BAYARD SAND.

In the eastern half of the county gas is found more frequently in paying quantities in the Bayard than in any other sand. In the western half of the county the Bayard horizon has not been reached by so many wells.

In eastern Greene County the distance from the top of the Fifth to the top of the Bayard sand in 60 wells averages 120 feet, and as the logs of the few wells which report the Bayard in the western part of the county record 130 feet between the same beds, the interval seems to be rather constant. The depth below the Pittsburgh coal varies from 2,388 to 2,464 feet, averaging about 2,433 feet for five townships in the eastern half of the county.

The thickness of the Bayard sand seems to vary considerably. A few wells have passed completely through it and their logs give 3 to 19 feet as the thickness, except the Eaton well in Jefferson Township, in which 50 feet was recorded. In other wells which stopped when gas was struck and did not go to the bottom of the sand a thickness of 20 to 30 feet is noted. The Bayard is sometimes known as the Sixth sand, although this name has also been applied to the Elizabeth. The name Bayard was introduced in gas-sand nomenclature in February, 1895, when a successful well was completed on the Thomas Bayard farm in Whiteley Township, Greene County.

ELIZABETH SAND.

This term is applied to a sand which carries some gas and is found at depths ranging from 100 to 175 feet below the top of the Bayard. Its thickness as recorded rarely exceeds 10 feet, but in one well 12 feet and in another 20 feet are reported. This last is the well on the J. P. Donley farm in Cumberland Township, in which the Pittsburgh coal was found at 555 feet and the Elizabeth sand at 3,007 feet. Probably the number of holes sunk to this sand in Greene County is less than 50. In the Warren Mankey well, near Nineveh, and in several wells farther south, the Elizabeth is reported as a red sand.

DEEPEST WELLS.

The deepest well ever drilled in Greene County was drilled in 1904 on the Benson heirs' farm, in western Aleppo Township, and reached a depth of 5,322 feet below the surface, or 4,722 feet below the Pittsburgh coal. This well recorded the Bayard sand 7 feet thick at a depth of 3,235 feet below the surface, and below this sand over 2,000 feet of rock are reported only as "shells and slate."

The second deepest well in Greene County was drilled on the M. L. Long farm in Perry Township in 1921 by the Carnegie Natural Gas Company. It rached a depth of 4,398 feet. The Pittsburgh coal was found at 470 feet, the Bayard sand at 2,867, Warren first sand at 3,525, Warren second sand at 3,598, and Speechley sand at 3,737. The well was dry.

A well drilled by the South Penn Oil Company on the Scott farm in the Bristoria field is said to be over 4,000 feet deep, and one on the Lewis Kuhn heirs' farm in Wayne Township reached a depth of 3,780 feet.

DESCRIPTION OF THE GAS FIELDS.

Natural gas is so widely distributed throughout Greene County, as proved by more than 1,600 productive wells, that it is impracticable to indicate separate fields. The county is one great gas field. Certain areas, as the western part of Cumberland Township and the Whiteley syncline have as yet proved unproductive and in general separate the southeast corner from the rest of Greene County by a narrow belt. Other areas, like that between Rutan, Woodruff, and Delphene, are unproductive at present, but they have not yet been thoroughly tested by the drill.

The following description is by tiers of townships from east to west.

CUMBERLAND TOWNSHIP.

The earliest drilling in Cumberland Township was unsuccessful, resulting in six dry holes. They ranged from 700 to 3,100 feet deep, and seem to have been fair tests, for subsequent drilling in their vicinity has generally been futile. Although much of the township seems to be barren, particularly the western half, a field has been found on the Brownsville anticline. The hills in the triangle between Monongahela River, Little Whiteley Creek, and Glade Run have been drilled in late years with considerable success, more than 40 gas wells and about 10 dry holes. The axes of the Brownsville anticline and Lambert syncline converge here to within a mile of each other with so little difference in elevation that they are barely distinguishable. The gas field extends across both axes. Gas has been found also in the western end of the township, but the producing wells are nearly surrounded by dry holes.

The wells in the southeastern corner of the township near Little Whiteley Creek were drilled by the Carnegie Natural Gas Company since 1920, and those east of Carmichaels by the Greensboro Natural Gas Company. The gas comes from the Thirty-foot, Fifty-foot, and Elizabeth sands. Five wells among the Greensboro company's group are producing oil from the Fifty-foot sand. In February 1928, according to G. J. Darrah, of Carmichaels. there were 48 producing wells in this field. Two of those drilled by the Greensboro company have been producing for 15 years.

MONONGAHELA TOWNSHIP.

Not including the shallow wells drilled on Dunkard Creek half a century ago, about 50 wells have been drilled in Monongahela Township. Of these, three in the Blackshire pool produced oil, 16 yielded gas, and 31 were dry. Seven of the gas wells are on the bank of Monongahela River, i. e., one at the mouth of Dunkard Creek, 3 at Greensboro, one near the mouth of Whiteley Creek, and 2 above Hatsfield ferry. Three gas wells a mile east of Ceylon mark the southern end of the field in Cumberland Township. and the others are scattered. Only 8 gas wells have been completed in 25 years.

The axis of the Brownsville anticline crosses the northwest corner of the township, and the axis of the Lambert syncline extends south from Paisley. Gas is found mainly in the Big Injun sand.

DUNKARD TOWNSHIP

Deep drill holes are fairly well distributed over Dunkard Township. except in about 2 square miles south of Dunkard, and in the northwest corner, north of Meadow Run. Six successful gas wells have been drilled on the bank of Monongahela River between Dunkard Creek and the State line, and 2 along the road up the hill opposite Point Marion.

A dozen successful wells were drilled in 1904-5 on the Durr, Keener, Watson, and Titus farms, a little over a mile east of Dunkard village.

Gas has been found in several wells around the Garrison oil pool in the northeast corner of the township and from this pool south across the township to the State line is a belt of wells. A few gas wells were brought in many years ago near Davistown, and more recently between Meadow Run and Bowen Fork.

Practically all of the gas produced comes from the Big Injun sand.

GREENE TOWNSHIP

Twenty years ago, three wells in Greene Township had produced gas. two on the Fordyce farm on Frosty Run and the Hugh Keenan well near Turkey Knob. In fact very few wells had been drilled except in the Willow Tree oil pool. In 1926 there were 35 gas wells in the township, extending from the Brownsville anticline on the east to the Whiteley syncline on the west. Several wells in the western end of the township are in dry territory.

JEFFERSON TOWNSHIP.

Jefferson Township lies along the eastern flank of the Bellevernon anticline. The structure is gentle, averaging less than 50 feet to the mile. More than 60 wells have produced gas, 15 to 20 were dry, and no well has yielded enough oil to be classed as an oil well. Wells are most numerous in the south end of the township.

The first two wells in the township were drilled at Rices Landing. One of these was sunk in 1860 on the bank of Monongahela River, 50 feet from the mouth of Pumpkin Run, and got a little gas. Another well, drilled about the same time, at an old mill half a mile up the run, showed a sign of oil. Nothing is known of the depth of these wells or in what sands oil and gas was found, but it is said that neither paid for drilling.

MORGAN TOWNSHIP.

More than 100 wells have been drilled in Morgan Township, resulting in 100 gas wells and 7 or 8 dry holes. The axis of the Bellevernon anticline crosses the eastern part of the township and the Waynesburg syncline lies beyond the western boundary. Four of the dry holes are south of Lippincott within one mile of the crest of the anticline. As they are surrounded by gas wells, they must have found a small area where the sands are tight. The Shape well, drilled many years ago at Castile, struck a strong flow of salt water in the Big Injun sand, but other wells along the western boundary and at nearly the same structural position produced gas.

Near Clarksville the gas comes largely from the Gantz and Bayard sands. Elsewhere the Big Injun, Fifty-foot, and Fifth sands carry some gas, although the largest flow comes from the Bayard sand. Drilling to the Elizabeth sand is likely to be worth while, for in the Zollarsville field it is a strong producer.

Further drilling in Morgan Township is practically assured of success, for the whole township seems to be productive and new wells virtually will be merely closer drilling in proven territory.

FRANKLIN TOWNSHIP.

Franklin Township, like Morgan, lies on the west flank of Bellevernon anticline. The crest of the Bellevernon anticline in the east part of the township might have been assumed in the early days of drilling to be the most likely territory but drilling has been successful in practically all of the township. About as many dry holes were found high on the anticline as along the western side of the township in the syncline. The most unproductive area is in the syncline from Tenmile Creek north through Rees Mill, although even here there are at least three gas wells directly on the axis of the syncline.

More than 250 wells have been drilled in Franklin Township and about 20 per cent were failures.

Drilling for gas in Greene County was begun, so far as records show, at Waynesburg in 1885, where a well was sunk by the Waynesburg Gas Company at the mouth of Purmans Run. The record of this well was published in the Annual Report of the Geological Survey of Pennsylvania for 1886, part 2, page 772. The well, although favorably located, was not successful, for while drilling in a promising sand, with a show of oil at a depth of 2,745 feet, the cable parted; the drillers were unable to regain the tools and the hole was abandoned. Had the well been sunk only a few feet deeper a strong flow of gas would, without doubt, have been struck.

As it was, gas was not found in this field in paying quantity until April, 1889, when a well was drilled on the Grimes farm, on Grimes Run, 1½ miles above its mouth and 2 miles northeast of Waynesburg. This well was 2,900 feet deep and yielded gas for many years. The record of this well and of the well on the R. A. Sayers farm 2 miles east of Waynesburg were published by the Second Geological Survey of Pennsylvania in Report I 5, 1890, page 312-313.

Active drilling in the immediate vicinity of Waynesburg followed the discovery of gas on the E. M. Sayers farm, just west of the Waynesburg and Washington Railroad station, in February, 1900. This well was sunk in the flood plain of the creek and reached the Bayard sand at a depth of 2,945 feet below the surface.

Many of the wells in this township get small quantities of gas in the Big Injun, Gantz, Gordon, and Fifth sands, but the Bayard is the greatest producer.

WHITELEY TOWNSHIP.

In 1905 there were 17 wells in Whiteley Township, 14 yielding gas and 3 dry. In 1925 there were about 112 wells that were or had been gas producers, and 30 dry holes. The Whiteley syncline crosses the township in a northeast direction, passing near Kirby, and the Bellevernon anticline is close to the west boundary. More than half of the dry holes are within a mile of the synclinal axis, and practically all producing wells are west of a line through Fordyce and Luke.

The Thomas Bayard well, in which a deep sand lying below the Fifth sand and now known as the Bayard sand was discovered, is on the head of Mount Phoebe Run in the extreme northern part of the township. This well was drilled in February, 1895. The distance from the Pittsburgh coal to the top of the Bayard sand in the original well is 2,410 feet. Some presumably productive territory southwest of Cummins is as yet undrilled.

PERRY TOWNSHIP.

In 1905, besides the oil wells at Mount Morris, Perry Township had only four gas wells east of that village and one on Shannon Run 1½ miles above its mouth. Three dry holes in a line across the southern part of the township suggested possible barrenness, but in the last 20 years many wells have proven the error of this supposition. Now there are about 50 gas wells between Mount Morris and Rudolph Run and 25 dry holes. These gas wells are mostly on the northern continuation of the Mooresville anticline. A small group of gas wells in the northwest corner of the township is separated from the larger group by the Whiteley syncline in which several holes were unproductive.

The principal production is from the Big Injun and Bayard sands.

WASHINGTON TOWNSHIP.

Less than 20 wells have been drilled in the east half of Washington Township and two-thirds of these were dry holes. In the west half of the township, however, about 40 gas wells, 40 oil wells, and 20 dry holes have been completed. The barrenness of the eastern part of the township may be due to the course of the Waynesburg syncline, which has a northeast course through Ruff Creek P. O. The writer is at a loss, however, to explain the position of the oil wells which, so far as drilled, are a narrow belt extending up the structure and over the crest of the Amity anticline. They are an extension of the Fonner oil pool of Morris Township. Gas wells occur on the crest of the anticline near Swarts and also in the midst of the oil wells. Several gas wells are much lower on the flank of the anticline than the structurally lowest oil wells.

The wide distribution of dry holes in this township, the very gentle structure, and the large proportion of dry holes to productive wells, is discouraging to further drilling here.

WAYNE TOWNSHIP.

Although the axes of the Bellevernon anticline and Waynesburg syncline cross Wayne Township, the difference in elevation between them is less than 200 feet, and the geologic structure in the whole township is only gentle warping. Certain sands are gas-bearing and the whole township has been prospected with the drill. Gas wells seem to be as abundant in the syncline as on the anticline.

Drilling over a period of 25 years had resulted in 1925 in 175 gas wells, 30 oil wells, and 25 dry wells. Groups of wells that formerly constituted individual fields now are merged in one field that includes adjoining townships. Much of the gas produced in this township comes from the Fifth sand, although the Big Injun, Fifty-foot, Gordon, Fourth, and Bayard are productive in some wells.

MORRIS TOWNSHIP.

The Amity anticline lies along the east boundary of Morris Township and the Nineveh syncline crosses the middle. The extreme western corner of the township is on the axis of the Nineveh anticline. Theoretically the occurrence of oil and gas in this township is peculiar. Oil occurs on the crest of an anticline as well as in the bottom of a syncline. So does gas. Territory between gas pools having the same structural relation and that presumably should be gas-bearing, is dry. The proportion of dry holes to producing wells is much larger than in most other townships. Between 1889 and 1925 about 207 wells were drilled in Morris Township, of which about 60 produced oil, 77 gas, and 70 were dry.

Gas wells are clustered high on the Amity anticline near Sycamore and Swarts, in the syncline west and north of the Nineveh oil pool, and between Graysville and Time. Northeast of Time where gas might be expected, in an area of about 4 square miles, 10 dry holes have been drilled. Gas occurs in wells structurally below, above, and on both sides of this dry spot. Another spot seemingly proved dry lies between Nineveh, Deerlick, and Browns Creek.

CENTER TOWNSHIP.

In 1905 a dozen or more wells on Pursley Creek below Oak Forest and on Stewart Run constituted the only gas field in this large township. Although low in the Waynesburg syncline they gave fair quantities of gas from the lower sands. A few other scattering wells were producing gas, and several dry holes had been drilled, particularly in the northwest corner of the township. About 44 wells had been drilled, of which 16 were dry, and 9 produced oil.

In)1925 there were about 144 gas wells, 17 oil wells, and 65 dry holes, or 226 wells in all. All but 4 of the gas wells lie east of a north-south line from the northern point of the township down Scott Run and thence to Woodruff. About 30 dry holes west of this line indicate the general lack of gas in this part of the Nineveh syncline. The eastern two-thirds of the township is demonstrated to be widely gas-bearing, both on the Amity anticline and in the Waynesburg syncline. Dry holes in this part of the township seem to bear no relation to the geologic structure, occurring in about equal numbers on both axes.

Gas comes from the Big Injun, Fifty-foot, Fifth, and Bayard sands.

JACKSON TOWNSHIP.

Gas wells are so evenly distributed in the southern two-thirds of the township that they constitute an almost continuous field, which is merely part of the great gas field that crosses several townships. The count of wells in 1925 was about 80 gas wells, 79 oils wells, and 26 dry holes.

Much of the gas comes from the Gordon, Gordon Stray, Fourth, and Fifth sands. Several holes near Nettle Hill were dry, although plenty of wells structurally above and below these are gas producers.

GILMORE TOWNSHIP.

Twenty years ago the only wells in Gilmore Township were a few gas wells near Jollytown and three scattered wells, in all including dry holes not more than 20 wells. Drilling has progressed successfully across the whole northern half of the township, and on the west of Jollytown. The southwest quarter of the township has barely a half dozen wells as yet, but so far as structure is concerned, may be expected to be gas-bearing. In 1925 the township contained about 68 gas wells, 4 oil wells, and 12 dry holes.

The Fifth and Big Injun sands are the principal producers near Jollytown.

RICHHILL TOWNSHIP.

Richhill Township has been fairly well drilled, although more than one area of nearly a square mile lacks a deep hole. In 1925 there were more than 280 wells, including 200 gas wells, 35 oil wells, and 50 dry holes. The broad triangular knob-like summit of the Washington anticline is the conspicuous structural feature of the township. It is generally gas-bearing, for producing wells are scattered over it, with a rather continuous line along the axis, particularly near Wind Ridge, and along the creek from Ryerson Station to Durbin. Considerable land just north of Crabapple Creek and also between Ryerson Station and the State line has been drilled very sparsely.

Gas is found at a number of horizons, including the Salt, Big Injun, Nineveh, Gordon Stray, Gordon, and Fourth sands. Owing to its occurrence in the upper sands, gas is often used in drilling the lower portion of the well. The principal operator in the early days of drilling for gas in this township was the Natural Gas Company of West Virginia.

ALEPPO TOWNSHIP.

The Nineveh syncline crosses this township diagonally. Along its axis gas wells are rare, some holes are dry and oil wells are more common. A small group of gas wells in the extreme southeast corner of the township is part of the gas field extending through New Freeport and Delphene. A dozen gas wells are mingled among the oil wells in the eastern part of the township, but most of the gas wells are west of Aleppo on the flank of the Washington anticline. About 241 wells have been drilled in the township, 131 producing oil, 78 gas, and 32 were dry. The gas wells in the oil pool generally get their gas from the Nineveh sand, but those in the western half of the township find gas in several different sands. Some dry wells are surrounded by producers, as the Benson heirs' farm, 1.8 miles southwest of McCracken which was drilled to a depth of 5,300 feet, but was unproductive.

SPRINGHILL TOWNSHIP.

Although Springhill Township has not been completely tested by the drill, especially in the western third, it probably always will have more oil wells than gas wells. In 1925 the score was about 181 oil wells, 63 gas wells, and 17 dry holes, or 261 wells in all. Some of the gas wells are grouped in the northeast corner of the township, some on the Littleton anticline southwest of New Freeport, a few among the oil wells near Garrison, and the rest are scattered. Gas is produced from the Nineveh, Gordon, Fourth, and Fifth sands. Some of the wells near Buzzard Run produced gas mainly from the Salvation sand, but a few find it in the Gas, Salt, and Big Injun sands. The lack of oil in some of these wells in the oil pool is explained by the fact that they do not reach the Nineveh sand. Gas has been found in at least two wells near the bottom of the Nineveh syncline with the same relation to the geologic structure as about 25 oil wells.

Wells in Greene County in 1925.

Township	Gas	Oil	Dry	Total
Aleppo	78	131	32	241
Center	144	17	65	226
Cumberland	40	3	10	53
Dunkard	71	110	46	227
Franklin	200	--------	50	250
Gilmore	68	4	12	84
Greene	35	50	28	113
Jackson	80	79	26	185
Jefferson	60	--------	20	80
Monongahela	16	3	31	50
Morgan	100	--------	8	108
Morris	77	60	70	207
Perry	50	75	25	150
Richhill	200	35	50	285
Springhill	63	181	17	261
Washington	58	40	32	130
Wayne	175	30	25	230
Whiteley	112	--------	30	142
	1,627	818	577	3,022

DESCRIPTION OF THE OIL FIELDS.

The oil fields of Greene County may be divided into two widely separated groups, one in the southeast corner and the other in the western half of the county. Some of the fields are of historic interest only; others are steadily producing and being extended. The fields in the southeast corner are Dunkard Creek, Garrison, Whiteley Creek, Blackshire, and Mount Morris. Those in the western half of the county have been called the Nineveh district and comprise a belt running from the northeast corner of Morris Township to the southwest corner of the county. Fields or pools included in this belt are the Fonner, Nineveh, Rutan, Grays Fork, Wright Run, Bristoria, Aleppo, New Freeport, Board Tree, and Garrison. The Lantz field in Wayne township stands alone.

EASTERN GREENE COUNTY.

DUNKARD CREEK FIELD.

Oil was first discovered in Greene County on the bank of Dunkard Creek a few hundred feet above the bridge 3½ miles above its mouth. This well on the Cephas Wiley farm was completed in 1864, and within a year between 75 and 100 wells had been drilled near by. The oil in this field was found mostly in the Dunkard sand, at a depth of about 450 feet below the Pittsburgh coal, which outcrops just above creek level. The wells were drilled by means of a spring pole, and most of them produced more or less oil. Having been drilled without casing, the soft shales were soon converted to mud by the flow of oil and water, and the holes caved, thus cutting off the flow of oil.

Several wells in the Dunkard Creek field were pumped for ten years or more. The oil was barreled and hauled to the mouth of the creek, whence it was shipped by boat to Pittsburgh. The field is midway up the flank of the Fayette anticline, on a structural terrace or minor fold. Oil has not been produced here for many years and the Dunkard Creek or Bobtown field is but a matter of history.

GARRISON FIELD.

In June, 1876, Abner P. Tanner, of Pittsburgh, drilled a well 2 miles south of Willow Tree, on the Garrison farm, at a point where the highway crosses the run. The result was a 50-barrel well in the Dunkard sand. For 28 years, or until 1904, this well was pumped steadily, the yield falling off gradually until the well was abandoned. Although this well was successful, so far as can be learned no further drilling was done until 1889, when several holes were sunk.

In 1905 there were about 70 wells in the field, 47 having been drilled on the Dan Garrison farm, hence the name of the field. It has also been called the Tanner field, in honor of the man who drilled the first well. Nearly 125 wells have been drilled in this field. In 1926 about 45 wells were producing, most of them owned by J. L. Girard & Company, Waynesburg, and the daily output was about 20 barrels. Some wells are being pumped that yield only 2 or 3 gallons a day. The oil is very high grade and brings the top of the market, $3.30-$3.60 per barrel.

Structurally the Garrisn field is on a small, gently sloping bench at the south end of the Lambert syncline.

WHITELEY CREEK FIELD.

The Whiteley Creek field lies on Whiteley Creek, in the southeast corner of Greene Township, about halfway between Whiteley and Mapletown. According to J. L. Girard, of Waynesburg, a small company was organized about 1865 to drill for oil on Whiteley Creek. His father, Stephen Girard, was one of the original company. The first well was drilled by Mr. G. Vance at Vance's mill, and the top of the Dunkard sand was reached 435 feet below the Pittsburgh coal. Oil was found 15 feet below the top of the sand and the well made 10 to 15 barrels daily. Stephen Girard accompanied the first shipment of 100 barrels of oil by boat to Pittsburgh and hoped to get 50 cents a gallon for it, but on seeing the thousands of barrels of oil from Oil City along the bank of the Allegheny River, he sold for 28 cents a gallon. Mr. Vance accompanied the second shipment of 100 barrels to Pittsburgh and returned without selling it. The well caved, tools and rope were lost in it, but the oil rose 250 feet above the sand and was pumped by Mr. Vance for 15 years or more.

About 1895 the Girard, Long & Lantz Company drilled 5 or 6 wells at this old mill. One of these wells was only 15 feet from the original well. It produced 18 barrels daily at first and yielded thousands of barrels in all. None are producing now.

In 1886 E. M. Hukill of Pittsburgh drilled a well on the Stephen Girard farm at Willow Tree and struck oil. This first well was begun 50 feet below the Waynesburg coal and drilled to a depth of 750 feet without getting oil. A second well was drilled on the same farm 600 feet east of the first well, and oil was found in paying quantity in the Dunkard sand. A small field was developed in the immediate vicinity on the Gregg farm. More than half of the 22 wells drilled on this farm were dry. Ten wells were producers and ranged in initial production from 1 to 25 barrels daily. Five wells on the Gregg farm were producing in 1926.

Much of the drilling near Willow Tree was done by the Girard Company between 1898 and 1903. This company has drilled nearly 100 wells in the Whiteley Creek field; only about half of them are shown on the map. In 1926 about 45 wells were making around 15 barrels of oil daily. The wells are pumped by a simple mechanical device at each well, which is operated by compressed air from a central station.

The Whiteley Creek field is at the south end of the Lambert syncline on the flank of a local shallow structural basin.

BLACKSHIRE FIELD.

A very small pool on Whiteley Creek where the hard road crosses north of Mapletown is interestingly suggestive though economically unimportant and long abandoned. The original well, drilled on the Blackshire farm about 1865, on the creek bank just above the bridge, started with a yield of 100 barrels or more a day. This production, however, rapidly declined and soon ceased. Oil was found in the Big Injun sand 1,250 to 1,350 feet below the Pittsburgh coal, which is here about 125 feet below the surface. A second well, just below the bridge, is said to have yielded 80 barrels a day at first by pumping, and a well drilled about the same time on the Stilwell farm a quarter of a mile below the bridge, is said to have gushed over the derrick for three or four hours. The oil softened the shale and the well was choked by caving about a day after it started to flow. Wells drilled to the Dunkard sand farther up and down the creek produced neither oil nor gas, but the pool may yet be extended, or redrilled to get the oil that was shut in by caving.

The pool is on very gentle structure close to the axis of the Lambert syncline.

MOUNT MORRIS FIELD.

The Mount Morris field is the northern extension of a pool developed for 30 miles and marked by producing wells to a point 6 miles southwest of Mannington, West Virginia. It lies at the foot of the western limb of the Fayette anticline. The first oil well in the Mount Morris field was brought in by E. M. Hukill October 21, 1886. It was on the bank of Morris Run half a mile southeast of the village, a 20-barrel well in the Big Injun sand. A well drilled one-eighth of a mile east of the original well produced 350 barrels of oil daily at first.

The Dunkard Oil and Gas Company was organized in 1892 and developed the field northward into Dunkard Township. The pool proved to be about 1,000 feet wide and very productive. Oil is found about 100 feet below the top of the Big Injun sand, and averages 1,377 feet below the Pittsburgh coal or 1,800 feet below creek level at Mount Morris.

Drilling was rather intensive around the village, about 50 wells having been sunk within half a mile of it. Mr. Robert Shear was a leader in this development. Many of these wells were pumping in the first years of the century but very few wells are now producing oil around Mount Morris.

The oil is transported by pipeline to a central pumping station on Monongahela River 2 miles above Morgantown, West Virginia, and thence to the seaboard.

WESTERN GREENE COUNTY.

FONNER FIELD.

Oil was discovered in March, 1897, in a well drilled on the farm of William Fonner in the northeast corner of Morris Township. This first well produced 1,800 barrels a day for a short time and then declined. A number of wells were drilled in 1898-99 to the Gantz sand, which yields the oil. In several wells gas was found just above the oil. The average depth of the oil-bearing sand below the Pittsburgh coal here is about 1950 feet or 2,700 to 3,000 feet below the surface, depending on whether the well is on a hill or in a valley. These early wells are on the western flank of the Amity anticline. Drilling on the Brooks, Bristor, and Shoup farms also found oil and was continued over the crest of the field and down the eastern flank. Three wells on the axis of the anticline produced gas but five or six wells equally near the axis yielded oil. Later drilling on the divide between Ruff Creek and Bates Fork in Washington Township resulted in a belt of oil wells two miles long on the Huffman, Meeks, and Closser farms. About 50 wells in this field have produced oil. The oil is piped to Meadowlands, Washington County.

NINEVEH FIELD.

Within 1½ miles of Nineveh about 20 wells have produced oil. These are mostly on the Smith, Throckmorton, Wolf, Funk, and Carter farms, close along the west side of the Nineveh synclinal axis, and constitute the Nineveh field.

Oil was struck in quantity in this field July 26, 1888, in a well on the John H. Smith farm at the first forks northwest of Nineveh. This well is recorded[1] as having flowed 3,940 barrels during the first thirty days. After two sets of tools had been lost in the hole, a string of casing was let down to the obstruction, and another hole was drilled past the lost tools into the oil-bearing sand. The well again started to flow at the rate of 310 barrels per day.

The oil in this field has come for the most part from the Nineveh sand, but seems in two or three wells to come from the Gordon Stray. The average depth of the Nineveh sand is 2,055 feet below the Pittsburgh coal in this field. This coal is 825 feet below the surface at Nineveh, making the wells 2,900 to 3,100 feet deep. The oil wells are less than 50 feet above the bottom of the Nineveh syncline. Gas is found slightly higher up the western flank.

RUTAN FIELD.

The Rutan field is not at Rutan, but on the Rutan farms in the southwestern part of Morris Township on Brush Fork of Browns Creek. The first well in this field was brought in on the T. F. Rutan farm in 1926. About 15 wells have produced oil. They are on the western flank of the Nineveh syncline between 50 and 100 feet above the bottom of the trough. Several wells nearer the trough were dry, and wells on the west edge of this small pool yield gas. Oil in this field is mostly in the Nineveh thirty-foot sand. In April, 1927, the Consumers Gas Company got a 140-barrel oil well on the James Rutan farm in the Gordon sand. About 20 wells were producing in January 1928.

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[1] Carll, John F., Seventh report of the oil and gas fields of western Pennsylvania: Pennsylvania Second Geol. Survey, Rept. I 5, p. 310, 1890.

GRAYS FORK FIELD.

This small pool on Grays Fork 1¾ miles southeast of Graysville is also known as the Harvey field because most of the wells are on the Chas. T. Harvey farm. All of the 11 oil wells here are within a circle half a mile in diameter and within one mile of the Nineveh synclinal axis. Several wells slightly higher on the structure were dry. The oil comes from the Nineveh sand.

WRIGHT RUN FIELD.

Twenty-five years ago when there were only two oil wells and one gas well on Wright Run, it seemed likely that, on account of its position halfway up the steep anticlinal slope, the field probably did not contain much oil. Drilling up and down the run has resulted in 13 oil wells and 8 or more gas wells. The gas occurs structurally above and below and between the oil wells. The oil is believed to occur in the Gordon Stray or upper part of the Gordon sand.

ALEPPO FIELD.

A group of 12 oil wells at Aleppo originally constituted a separate field or pool. Further drilling brought in about 20 more oil wells and closed the gap between this field and the northern end of the New Freeport field. These wells are in the Nineveh syncline on both sides of the axis, and get oil in the Gordon, Fourth and Fifth sands.

If we include 9 oil wells on the Whipkey, Barnhart, and Strope farms on the head of Wagonroad Run as in this field, it has been extended more than two miles south of Aleppo. It seems probable that all the area between Aleppo and Windy Gap church may prove to be oil-bearing; the vicinity of Morford also looks promising for oil.

The Pittsburgh coal is 900 feet below the creek at Aleppo, and 1,200 feet below the mouth of wells high on the hills. Add to this the 2,200 feet between the coal and the Fourth sand and we have 3,100 to 3,400 feet to reach the oil sand.

BRISTORIA FIELD.

South of Grays Fork along the Nineveh syncline there are no oil wells for three miles. A number of holes drilled between the Grays Fork field and the southwest corner of Center Township were dry. Beginning at the township corner on the head of Lick Run and extending south beyond Higbee and west to Bristoria is a field including about 140 oil wells in an eliptical area 4 miles long and 3 miles wide. The field is almost entirely on the east side of the Nineveh syncline, though a dozen productive wells lie west of the axis. Most of the oil comes from the Nineveh sand and a large quantity has been produced since the field was opened in 1896. Scattered through the field are a few gas wells, and a belt of gas at Bristoria seems to separate this field from that on Wright Run. Gas wells mark the boundary of the field on the south at Delphene. Two dry holes and less than a mile lie between this field and the northern end of the New Freeport field.

NEW FREEPORT FIELD.

A very definite belt of oil wells 7 miles long and up to one mile wide, extending from near Aleppo to the south line of the county, is called the New Freeport field. There are about 160 oil wells and 15 gas wells in this belt. The northern end of the belt is close to the bottom of the Nineveh syncline, but the belt diverges from the axis at an angle of about 20 degrees and ascends the gentle structure on the east until it crosses the crest of the low Littleton anticline on the head of Buzzard Run and down into the Burchfield syncline in West Virginia. On the top of the anticline two miles south of Deep Valley there is one gas well for every 3 oil wells.

The Nineveh is the productive sand in this field, although a few wells obtain oil in the Gordon. The Salt, Gordon, and Fourth sands produce some gas. The field has been producing oil since 1896.

GARRISON FIELD.

Within a mile of Garrison in the southeast corner of Springhill Township, a dozen or more wells have been drilled, and most of them produce oil. Some of them are along a water course leading to Hamilton Run, some on the head of Dunkard Creek, and on top of the ridge between the two streams. The first well in this field was brought in April 1, 1912 on the Joseph Kuhn farm. The oil comes from the Stray and Fifth sands.

Another small group of oil wells lies 1½ miles northeast of Garrison close to the east line of Springhill Township. In 1926 there were 8 wells in this pool getting oil from the Nineveh sand.

Both of these pools near Garrison are on or near the axis of the Robinson syncline which enters the county from the south and terminates probably in the vicinity of Nettle Hill. Gas wells seem to shut in this oil belt on the north so that it cannot be extended even to the northwest corner of Gilmore Township.

BOARD TREE FIELD.

The Nineveh syncline swings to the south in Springhill Township and crosses the State line just north of where Fish Creek crosses it. On the east side of this axis four wells near the forks of Coon Run produced oil, as did three wells at the mouth of Fall Run. Further drilling has resulted in a pool of about 20 wells on Fish Creek between the mouth of Pigeon Run and the State line. Another group of more than a dozen wells in the same relation to the syncline has been drilled on the Miller, Strope, Moore, and Isiminger farms in the northwest part of Springhill Township. The mile or more between these two groups of wells may eventually prove to be oil-bearing. A pump station of the South Penn Oil Company, which has developed this field, is situated at the mouth of Coon Run.

LANTZ FIELD.

The Lantz oil field is the north end of a large pool extending over the State line into West Virginia. It is in Wayne Township near the junction of Hoovers Run and Dunkard Creek. The village of Brave is in the midst of the pool. Operations in this pool date from 1899, when the William Lantz No. 1 well was drilled three-eighths of a mile below the mouth of Hoovers Run. Most of the oil is produced from the Fifth sand. Between 25 and 30 oil wells were completed in this pool within 6 years of its discovery. Wells drilled since then have produced gas and seem to enclose the oil pool. The structural position of the Lantz pool is half way between the Bellevernon anticline and Waynesburg syncline where the dip is gentle.

MISCELLANEOUS OIL WELLS.

A number of wells not in the above-described fields are reported to have obtained oil. Most interesting are two wells drilled in 1893 on the Lantz farm at the mouth of Woods Run, Greene Township. They are said to have filled up 100-300 feet with oil when the Big Injun pay was tapped. Drilling and fishing tools were lost in one of them, and neither of the wells was ever pumped. The southwest corner of Greene Township has not been drilled enough yet to determine whether there is an oil pool in this vicinity.

A well on the road three-fourths of a mile west of Whiteley on the Rice farm found a small showing of oil in the Big Injun sand and the L. L. Thomas well on the north side of the State line at Blacksville produced some oil from the Fifth sand.

A well on the bank of Monongahela River at Greensboro is said to have yielded about a barrel of oil a day from the Dunkard sand, which was reached at a depth of 300 feet.

The Mosley well, 1½ miles east of Jefferson, obtained some oil from the Dunkard sand, and the Ellen Ross well on Ruff Creek, five-eighths of a mile above Ruff Creek post-office, obtained about one barrel of oil daily from the Gantz sand.

The Headley well on Little Shannon Run, 2½ miles above the mouth, is said to have made a good showing of oil, but when the well was shot the oil was drowned out by salt water. The record does not state in what sand this oil was found. Later drilling has discovered oil in several wells on Little Shannon Run.

In the Joseph Morris farm, 3 miles northwest of Blacksville, West Virginia, oil was pumped from the Gordon sand for several years.

A trace of oil has been found in several other wells in different sands, but in no case in commercial quantity.

METHOD OF PRODUCING OIL AND GAS.

Oil and gas are obtained by drilling holes to the reservoir rocks deep below the surface. When the site of a well has been determined, heavy timbers are arranged in a square for the foundation of the well rig. The common derrick is a tower or frame work of lumber about 70 feet high, tapered, and cross braced, on a base 20 feet square. A sheave wheel at the top carries the cable used in drilling, and a separate pulley holds the line by which the sand pump is operated. The rig includes also a bull wheel on which the drilling cable is wound, a walking beam which alternately raises and lowers the drill, and an enclosed engine house. Fig. 37, a photograph of an old oil well near Mount Morris, is a typical carpenter's rig.

In the last few years derricks made of tubular steel and braced with steel have been used. For permanent structures they resist wind better than carpenter's rigs. Fig 38 is a steel rig half a mile northeast of Mount Morris.

Wells are drilled in Greene County by the percussion method, known as churn drilling. A heavy steel bit suspended on a cable passing over a sheave at the top of the derrick is raised and lowered by a walking beam driven by a steam engine. The driller pays out the cable a little at a time by turning a temper screw, and also rotates the bit. The steel bit striking the rock several times a minute grinds

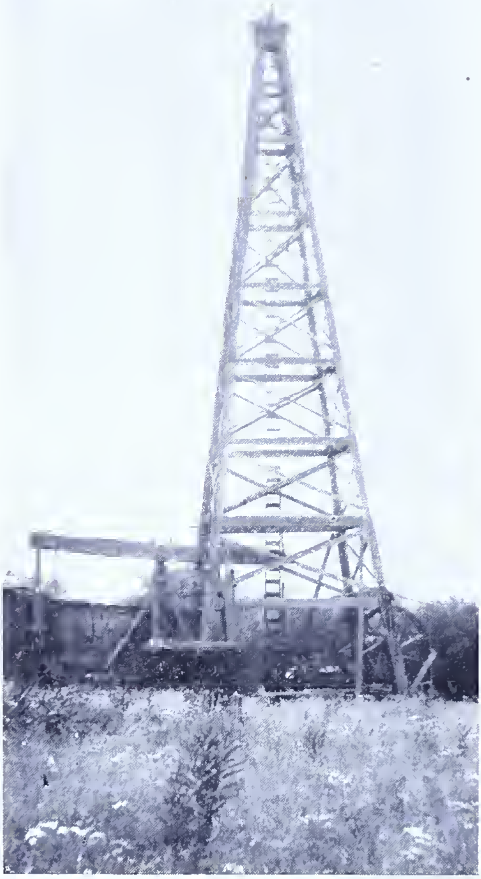

Fig. 37. Typical wooden well rig.

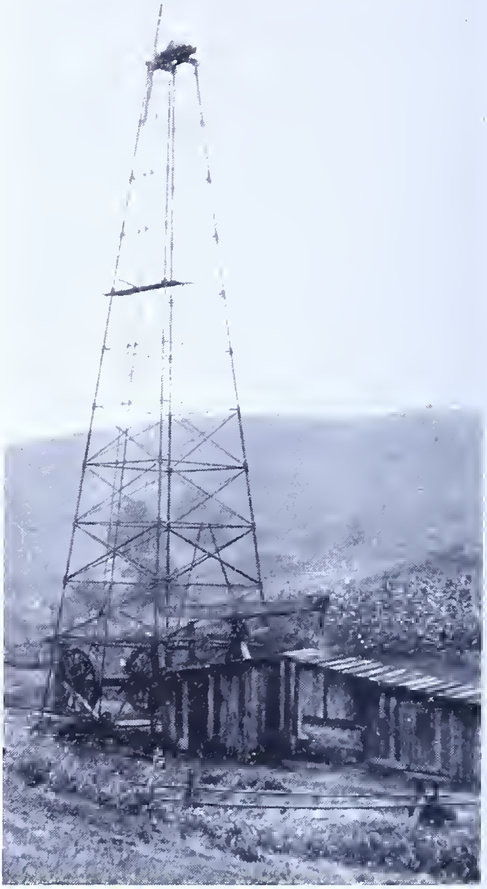

Fig. 38. Modern steel well rig.

it to powder and so makes a hole. An 8-inch bit is used for the first few hundred feet and smaller bits at greater depth. The sand and mud made by the drill crushing the rock is bailed out by lowering into the well a sand pump, which is a pipe with a trap in the bottom.

Iron pipe or casing is forced into the hole and follows close behind the drill to shut off water and prevent caving. When a well is completed the drill is removed, the well is capped with a casing head, and, if producing gas, is connected into an underground pipe line, as shown in Fig. 39. The natural pressure causes gas to flow from the well into the pipe line. If the well produces oil it may flow naturally or it may be raised by a pump, and delivered to a tank at the well, or to a pipe line. It is these pipe lines carrying the oil and gas from the individual wells to market that are discussed in the following pages.

OIL AND GAS PIPE LINES.

Some people are surprised on looking into an excavation in a city street to see a network of gas, water, steam, telephone, electric and sewer pipes, whose presence is not indicated at the surface. Cities are not the only places where pipes are put under ground. Natural gas is transported many miles in large pipe lines from the producing fields to manufacturing centers, and oil is moved underground hundreds of miles from the oil pools to refineries. Oil pipe lines have

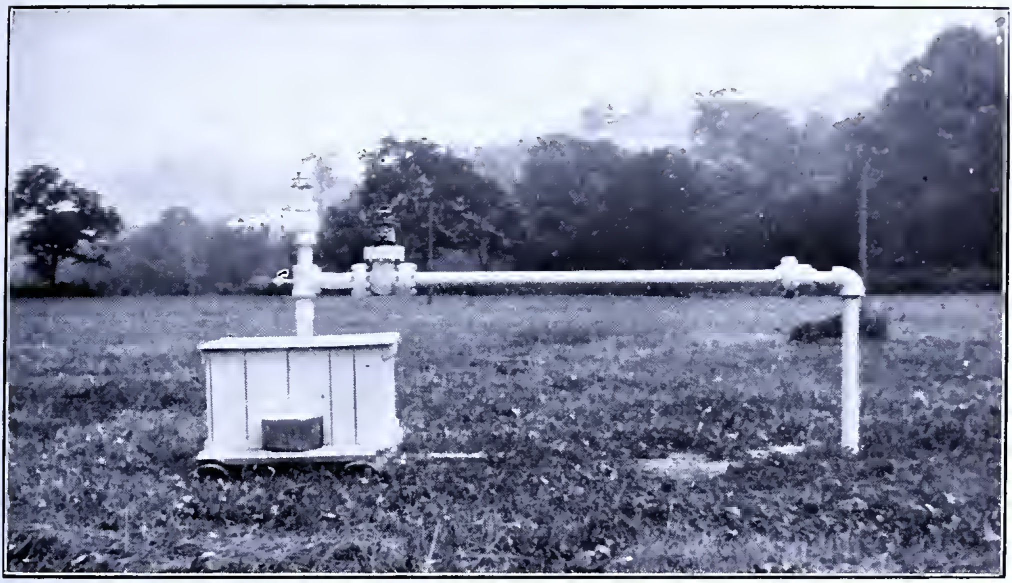

Fig. 39. Gas well connected into pipe line.

long existed from the pools of West Virginia and western Pennsylvania to the Atlantic seaboard. As the gathering grounds have extended westward the trunk pipe lines have been extended until now oil from north Texas and Oklahoma can be transported through pipes to Perth Amboy, New Jersey.

The first successful pipe line for transporting petroleum was laid in Pennsylvania in 1865. It was four miles long and carried oil from Miller's farm to Pithole, Venango County. It was constructed of 2-inch screw pipe. Pine lines carried oil across the State to the Atlantic seaboard in 1881. Today there are thousands and thousands of miles of pipe line in Pennsylvania. More than 1,400 miles of pipe two inches or more in diameter have been laid in Greene County. The accompanying map, Plate III, shows the location of most of this underground transportation system. This map was prepared by the generous cooperation of the companies whose names appear on it. As measured by a map measuring instrument, the number of miles of pipe shown for each company is approximately as follows:

Pipe lines in Greene County.	*Miles*
Carnegie Natural Gas Company	168
Equitable Gas Company	416
Greensboro Gas Company	56
Manufacturers Light & Heat Company	286
Peoples Natural Gas Company	251
Randall Gas & Water Company	27
Consumers Fuel Company	10
Gas	1,214
South West Pennsylvania Pipe Lines	165
West Virginia Pipe Lines	34
Oil	199
Total	1,370

The map does not include many miles of small lines to individual wells. These figures represent the principal lines as drawn by the respective companies on topographic maps of one mile to the inch scale. Some companies showed many of their small branch lines; some only the larger lines, so comparison between companies should not be made on these figures.

Although admittedly not accurate these figures do show that about 85 per cent of the total mileage carries gas, and that the Equitable Gas Company has considerably more pipe line in Greene County than any other company. This company alone has dug over 400 miles of trench for laying its pipe line, a distance equal to that from Pittsburgh to Atlantic City, via Altoona, Harrisburg and Philadelphia.

OIL LINES

Oil was first produced commercially in Greene County on Dunkard Creek three miles above its mouth in 1864, and on Whiteley Creek two miles below Whiteley in 1865. The oil was put in barrels, hauled to the Monongahela near the mouth of Dunkard Creek and shipped down river to Pittsburgh by boat. This was the only method of delivery to market for many years. When the oil fields in the adjacent part of West Virginia were brought in, a pipe line was extended to Mount Morris and to Whiteley Creek. A pump station at Mount Morris drove the oil to a central station on Monongahela River 2 miles above Morgantown, W. Va., and thence it was pumped to the seaboard.

The first pipe line across Greene County was a 6-inch line entering the county 3 miles west of Mount Morris and going north to Washington County. This was laid in 1891 and is now one of four lines of Southwest Pennsylvania Pipe Lines following this course and carrying oil to a tank farm at Meadowland, Washington County.

The first line of the West Virginia Pipe Lines, laid in 1912, is a 3-inch main from Littleton, W. Va., entering the county at the southwest corner, and going out at Burdette. This line delivers crude oil to Burgettstown, to be delivered through Valvoline Pipe Lines to refineries at Butler, Pa.

Oil from gas wells is trapped at the wells and piped to oil mains, where the quantity justifies, or delivered to tank cars. The Carnegie Natural Gas Company loads a small quantity of petroleum in tank cars at Rices Landing.

As oil pools have been developed in different parts of the county, pipe lines have been extended to them. The main trunk lines are 3 to 8 inches in diameter, and 2- and 3-inch branches extend to small pools and individual wells. The main lines pursue a direct course for miles, regardless of topography, thus using less pipe and avoiding the difficulty of trenching along the streams and roads in the bottoms of narrow valleys.

South West Pennsylvania Pipe Lines has more than 200 miles of lines in Greene County and West Virginia Pipe Lines about 35 miles. As shown in part by the accompanying pipe line map, the South West Pennsylvania Pipe Lines has a 5½-inch line following a straight course for 40 miles from Littleton, W. Va., to Meadowlands, in Washington County, passing one mile east of Wind Ridge and just east of Time. A 6-inch line crosses Richhill Township near Durbin and Burdette. Numerous lines gather oil from the pools between Garrison and Bristoria. A 6-inch pipe runs from Downs Station, W. Va., northward through Spraggs and on Smith Creek joins lines from a pump station at Cove on Dolls Run, W. Va. These lines entering Greene County 3 miles west of Mount Morris are two 6-inch and two 8-inch pipes. Their course deflects only slightly from a straight line to the mouth of Overflowing Run 3 miles west of Waynesburg. Thence these pipes go due north. North of Smith Creek crossing this system consists of two 8-inch and three 6-inch mains. A 3-inch feeder from the Rutan and Nineveh fields follows Browns Fork.

A 2-inch line gathers oil from Willow Tree and Whiteley Creek to the pump station at Mount Morris.

The West Virginia Pipe Lines system in Greene County includes the 3-inch main across the west end of the county, a 2-inch line from Sugar Grove pump station near McCracken to the State line on the west and thence nearly to Moundsville, W. Va.; and a 2-inch line from the same pump station to Aleppo and down Wagonroad Run to the wells on Fish Creek below Deep Valley.

GAS LINES.

Gas lines in Greene County make a network like the cracks in a much-shattered sheet of glass. Main lines cross the county from the southern to the northern border in different directions but with fairly direct to straight courses. Shorter lines branching from the trunk lines sprawl in all directions, some sinuously as they follow streams, but most of them with straight courses and angular bends.

Most of the gas goes by large pipe lines to the Pittsburgh district where it is used by manufacturers for steaming and heating, and by the city in general for heating, cooking, and lighting. The Carnegie Natural Gas Company delivers the main part of its gas to the Homestead, Duquesne, and Edgar Thompson steel works.

The first gas mains in Greene County were laid by the Carnegie Natural Gas Company in the fall of 1895. They were 10- and 12-

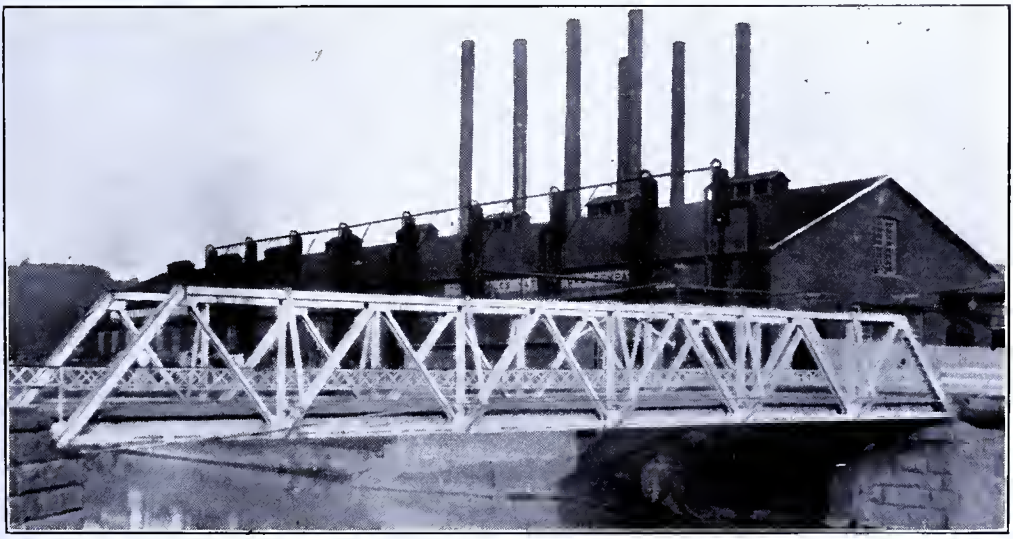

Fig. 40. Pumping station of Peoples Natural Gas Co. at Brave, Wayne Township, built in 1906.

inch lines from West Union to the southern part of Richhill Township, and from near Lone Oak church to the Eli Russell well east of Mount Morris.

A 20-inch line was laid by the Peoples Natural Gas Company from Brave northward along the Bellevernon anticline to the Washington County line east of Zollarsville in 1904, and the large compression station at Brave was built in 1906. Brave, then a hamlet at a country cross-roads, is now a village of about 500 people.

The Equitable Gas Company pipe lines extend to most parts of the county except the northwest sixth and the southeast corner. Manufacturers Light & Heat Company occupies the extreme western part of the county, and the central and southwestern part, but has almost no lines east of a line through Clarksville and Blacksville. The Peoples Natural Gas Company has its gathering lines in the southern half of the county and west of Whiteley and Mount Morris. In the northern half of the county this company has only its 12- and 20-inch trunk lines from South Fork of Tenmile Creek to Zollarsville. The Carnegie Natural Gas Company has more miles of pipe line in the eastern half of the county than in the western, and none in a large tract between Waynesburg, Nineveh, Bristoria, Jollytown, Brave, and Oak Forest. The Carnegie Company and the Greensboro Gas Company gather the gas along Monongahela River in Greene County, except that taken by the Equitable Gas Company from near Carmichaels. The Greensboro Gas Company also has a 12-inch line entering the county near Zollarsville and extending direct to Rogersville and thence northwest to wells near the Rutan oil pool.

The Greensboro Gas Company supplies gas to Uniontown and Brownsville, and the Randall Gas & Water Company of Morgantown, W. Va. takes gas from the southeastern part of the county to Point Marion and Morgantown.

Gas lines shown on the map range in size from 20 inches in diameter to 3 inches. The only 20-inch line belongs to the Peoples Natural Gas Company and extends northeast across the county from Brave parallel with a 12-inch line. Three 16-inch lines of the Equitable Gas Company cross the county from West Virginia in a northeasterly direction. Lines 10 and 12 inches in diameter are numerous. Connections to individual wells usually are 4- and 6-inch pipes.

LIMESTONE.

In every township in Greene County the outcrop of one or more limestone beds can be found. Of these the Benwood or Great limestone near Monongahela River is thickest, and the thin limestones in the western part of the county are of least consequence. In the pioneer days some of these limestones were used for making mortar and plaster. It is of record that the Waynesburg limestone was much used in the early days for this purpose. It was burned in primitive kilns and made a strong, dark lime. Lime suitably white for inside plastering was less easily obtained, but could be made from the dark, middle portion of the Upper Washington limestone occurring in the northern part of the county.

The glass works at Greensboro a century or more ago used the Fishpot limestone, as did also the early smelters of iron in this district.

Fifty years ago it was common practice for farmers to burn limestone in open heaps for use as a fertilizer. This rock was obtained either by assembling the loose blocks found along or below the outcrop of a limestone bed, or by opening a small quarry. This practice however virtually has ceased, although in 1925 two or three men were reported to have prepared and sold pulverized limestone for soil sweetener. Since 1920 some local limestone has been used as coarse aggregate in concrete highways but with unsatisfactory result. The stone seems to be softer than the cement and forms pits in the road surface. A small quantity of limestone is quarried by Township Commissioners for use in improving roads.

Benwood limestone. In the midst of the Monongahela group, or halfway between the Pittsburgh and Waynesburg coal beds, is the Benwood or Great limestone. In places it is 150 feet thick and a conspicuous stratigraphic horizon. The name is derived from an excellent exposure of this limestone at Benwood, 4 miles south of Wheeling, W. Va. It is commonly known also as the Great limestone.

The term Benwood limestone is restricted to the strata occurring between the Sewickley and Uniontown coals. This bed is never solid limestone, being broken up by layers of shale and thin sandstone into two large divisions. The lower division is about 60 feet thick, and is generally composed of alternating bands of limestone and calcareous shale. The limestone beds are usually less than two feet thick, although an occasional bed is 6 to 10 feet thick locally. The upper division of the Benwood limestone is of varying thickness, from 6 to 20 feet, and lies immediately under the Uniontown coal. It is composed of beds a foot or more thick with interstratified thin layers of shale. The lower division is more persistent than the upper and has a larger magnesian content. The analyses of samples collected by the writer in 1925 and those published by the Pennsylvania Second Geological Survey indicate that the composition is variable. The weathered surface of the limestone may be gray, almost white, bluish, or brownish; the fresh stone is dark blue, flesh colored, and drab.

Certain benches are pure enough for making lime while others are worthless. The texture varies from very fine to shaly. This limestone was used years ago in the Monongahela Valley for making natural cement, but its only use in Greene County, at the time of this writing, so far as the writer discovered, is for road metal. Nearly all of the beds might be used for agricultural purposes, but only a few would yield a strong building lime. The soil derived from the weathering of this limestone is rich, and makes good farming land.

The Benwood limestone is exposed at several places in the bluff of Monongahela River, as at the Dilworth mine just below Rices Landing where 30 to 40 feet of limestone is exposed as a vertical cliff along the railroad. In the mouth of Pumpkin Run at Rices Landing this limestone is exposed in quarries in both banks. On the south side of the run a quarry has been opened on a limestone bed about 15 feet thick, and is operated intermittently by the township or boro for road metal. A sample of this limestone collected by the writer from the whole length and height of the exposure shows that it is a magnesian limestone, containing 47 per cent calcium carbonate and 25 per cent magnesium carbonate.

On the north side of the ravine a quarry on the land of Dr. S. A. Hoge shows the following section:

Partial section of Benwood limestone at Rices Landing.

	Ft.	in.	
Limestone	1	3	
Shale, shaly limestone, and limestone	7	0	
Limestone, soft	3	4	Sample 5
Shaly, wavy parting		1	
Limestone	2	0	Sample 4
Wavy parting			
Limestone	1	0	
Shaly limestone		4	
Limestone 15 inches to	1	8	Sample 3
Shale and limestone	1	0	
Floor, streak of red shale	------		

Below the floor of this quarry to the main street of Rices Landing there is approximately 50 feet of limestone, part of which is represented by sample 2 from the quarry on the south side of the run. Along the road above the quarry on Dr. Hoge's land the rock sequence is 35 feet mostly limestone, 30-40 feet of sandy shale, then 4 feet of limestone that may be the Waynesburg bed.

Samples collected by the writer in the Hoge quarry show a wide variation in composition. The 20-inch bed of dark limestone just above the floor carries 95.78 per cent calcium carbonate and less than 2 per cent magnesium carbonate, but the 3-foot and 40-inch beds next above have only 65 and 66 per cent calcium carbonate and over 20 per cent magnesium carbonate, as shown by the analyses below. This result is in accord with the report by Stevenson[1] on the composition of the Benwood limestone in Washington County.

According to I. C. White, the Benwood limestone on the N. C. McClelland farm at the ferry 2 miles above Rices Landing, is 90 feet thick. This is not one solid mass of limestone; the layers of limestone are separated by calcareous shale 6 inches to 1 foot thick, nor is the limestone all of one kind. Mr. McClelland, prior to White's examination in 1875, had quarried and shipped a considerable quantity to the Pittsburgh iron and glass furnaces for flux. Some layers of the limestone will not slack when burned. some make agricultural lime, and some of it is called sodastone, owing to the fact that many years ago it was used in the manufacture of soda at an establishment in Pittsburgh.

On Bush Run, in a wooded ravine in the northern end of Jefferson Township, the Benwood limestone is exposed in the steep banks below the State Highway. It is in two parts separated by 35 feet of shale and sandstone. The upper part is 8 feet and the lower 85 feet thick. One mile farther north the highway descending to Tenmile Creek crosses this limestone but it is not well exposed. It is in the vertical cliff between the highway and the elbow in the creek.

At Clarksville the township commissioners have taken Benwood limestone from the bed of Tenmile Creek just above the village and crushed it for road use. A sample taken from stock in the bins at the crusher carried about 85 per cent calcium carbonate. There are particularly good exposures of this limestone in Castile Run and at the iron bridge across South Fork of Tenmile Creek 1½ miles below

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[1] Stevenson, J. J., Greene and Washington District. Pennsylvania Second Geol. Survey, Rept. K, p. 388, 1876, and MM. p. 285.

Jefferson. Near this bridge about 15 feet of limestone is exposed in a railroad cut. In this exposure it is noticeable that two lower benches totaling 5 feet thick come together or unite and almost feather out in a distance of 400 feet.

Redstone limestone. The Redstone limestone, closely underlying the coal of that name, crops out only in the valley of Monongahela River or close to it. Elsewhere in the county it is deeply buried. Although it appears to be lacking in the section at Rices Landing, the space between the Pittsburgh and Redstone coals being occupied by massive and flaggy sandstone, a few miles farther up the river this limestone is well developed.

The following description of the occurrence and section at Alicia No. 2 mine is by J. D. Sisler, of this Survey.

"At the Alicia No. 2 mine of the Pittsburgh Steel Company, located on the Greene County side of Monongahela River near Grays Landing, there is an interesting outcrop of limestone above the Pittsburgh coal bed, which at this point is about 20 feet above water level. The limestone, somewhat stratified with shale, is about 30 feet thick, and analyses over 90 per cent $CaCO_3$. A cut made for a tram road along the river bank uncovered this gray hard limestone and clearly exposed a considerable part of its thickness. It weathers yellow and is in layers of varying thickness.

"Where the tram road turns away from the river up a gully to the drift mouth, the character of the material overlying the coal bed undergoes considerable change, and instead of limestone or shale one finds reddish debris, without stratification, broken up and soft, and with a tendency to slide down on the tram road. In this broken-up mass several lumps of slag were found. There is no coal under this debris for a distance of 400 feet from the outcrop.

"According to the mine superintendent and Mr. Girod, State Mine Inspector (23rd District), this missing coal has been consumed by rapid oxidation, reaching such a temperature that the overlying limestone was burned and in some cases actually fluxed, forming slag. A forest fire may have ignited the outcropping coal. This unusual condition is found only at the mouth of the gully."

Section at Alicia No. 2 mine.

	Feet
Shaly sandstone	20
Sewickley coal	5
Shale	5
Limestone	3
Shale	3
Coal	0.5
Limestone	5
Shale	20
Redstone coal	3
Limestone	10
Limestone and shale	20
Shale	5
Pittsburgh coal	13

In this section, which was measured by Mr. Sisler, the limestone below the Redstone coal is a fairly solid bed, but the succeeding 20 feet is composed of several beds or lenses of limestone, of varying composition and hardness, and more or less interstratified with shale which is included in the measurement. Should this 10-foot limestone be of commercial value, several thousand tons of it could be quarried readily between the present tram and the steep rock bluff behind it. Shipment could be made by river barge.

This limestone is reported to make lime of fair quality, and some of it might be satisfactory for road metal.

Stevenson describes the section half a mile above Grays Landing as containing 25 feet of calcareous sandstone at this horizon, and mentions 16 feet of limestone in a ravine by the old glass works at Greensboro.

No use is now being made of the Redstone limestone in Greene County unless it is the rock quarried by township commissioners on the south bank of Tenmile Creek below Trumbull. The base of the bluff is accessible to wagons in summer and a quantity of stone has been taken here for road metal.

Fishpot limestone. The Fishpot limestone, which lies below the Sewickley or Mapletown coal, is exposed in the bluff of Monongahela River between the mouth of Tenmile Creek and Bush Run. It is 25 feet thick with sandstone above and sandy shale below, but difficult of access. About half a mile above Grays Landing this limestone is in two benches, 15 and 8 feet thick, separated by 10 feet of shale.

At Alicia No. 2 mine the section on a preceding page shows this limestone in two beds, 3 and 5 feet thick, separated by 3 feet of shale and a 6-inch coal bed.

Near the State line in Dunkard township the Fishpot limestone is one bed 8 feet thick with sandstone below and shale above.

It is probable that some geologists, especially those familiar with the stratigraphy of the Panhandle of West Virginia, would call the 3-foot limestone that lies 5 feet below the Sewickley coal at Alicia No. 2 mine the Sewickley limestone, and correlate it with the 15-foot limestone found 8 feet below the Sewickley coal near Grays Landing. No objection can be offered to this, but the thick limestone below Rices Landing is maintained to be the Fishpot because it is 40 feet below the Sewickley coal.

The quality of the Fishpot limestone is said not to be equal to that of the Benwood limestone. This statement needs further qualification for there is a great variation in composition of different beds of the overlying Benwood limestone. Analyses of the Fishpot limestone in Greene County are not available and the writer does not know any place in the county where it is quarried.

Waynesburg limestone. With fairly wide distribution in the eastern half of the county, the Waynesburg limestone may be said to have some prospects of greater use in the future than at present. It makes a strong dark lime, can be used for soil sweetener and for crushed stone, especially in localities not close to a railroad. The Waynesburg limestone is found 20 to 40 feet below the Waynesburg coal throughout Greene County and in southwestern Washington County, but is not present farther north or in Ohio. Its distance below the coal increases from north to south across Greene County. Its thickness ranges from 4 to 10 feet in most places, but a limestone on Dunkard Creek near Davistown 42 feet below the Waynesburg coal is 15 feet thick. On Monongahela River below the mouth of

Little Whiteley Creek the thickness of the Waynesburg limestone is 10 feet, below Muddy Creek 9 feet, and below Bush Run 6 feet. The rocks between it and the Waynesburg coal at these places are 35 to 40 feet of shale and shaly sandstone.

Near Jefferson this limestone is reported to be 7 feet thick but where the writer collected a sample for analysis from the outcrop at the highway concrete bridge over the railroad 1¼ mile southwest of Jefferson only about 4 feet of limestone was found although stripping might disclose a greater thickness. Other places where it is exposed and readily accessible are the lower half of Braden Run, mouth of Browns Run, on the road from Clarksville to Castile Run going over the hills, at the Ferncliff amusement park on Pumpkin Run one mile above Rices Landing, on Muddy Run 1 mile below Carmichaels, three-quarters of a mile east of Whiteley, and in the hollow three-quarters of a mile east of the mouth of Glade Run.

Below Carmichaels where the Waynesburg limestone lies in Muddy Run it was quarried and crushed by Hart Brothers of Carmichaels for agricultural limestone. This small recent industry, however, has been abandoned and the machinery removed. The writer collected a sample of the pulverized limestone from the few bushels remaining in the shed and analysis showed 66.84 per cent calcium carbonate, 12.95 magnesium carbonate, and 11.40 silica, which is very different from the analysis of the Waynesburg limestone from Jefferson in the table below.

Upper Washington limestone. About 400 feet above the Waynesburg coal and marking the division between the Washington and Greene groups is the Upper Washington limestone which has the widest distribution and longest outcrop of any worthwhile limestone in the county. It is high in the hills near Jefferson and Whiteley, near the valley bottoms north and west of Waynesburg, and goes below drainage near Deerlick, Woodruff, and two miles above Rogersville. It comes to light again near Time, Graysville, and McCracken, and is high in the hills near Durbin. This limestone is 4 to 9 feet thick and is readily recognized by its white, weathered surface.

According to J. J. Stevenson (Report K, page 46), "In Greene County it is readily identifiable everywhere except in the Fish Creek region. On Dunkard it is quite impure and bears little resemblance to itself as it ordinarily appears. It has been recognized in Morgan, Washington, Morris, Richhill, Aleppo, Centre, Franklin, Greene, Jefferson, Cumberland, Perry, Wayne, and Gilmore townships. Its thickness is from 4 to 8 feet, and the interval between it and the Washington coal varies from 325 feet on Dunkard, to 260 on Tenmile near Waynesburg, 190 on Ruff Creek, in eastern Washington, and 135 on Hunters Fork of South Wheeling Creek in Richhill. No difficulty is encountered in following this rock from its northwestern exposure in Smith township, Washington County, to Whiteley Creek in Greene township, Greene County."

Where the outcrop of this limestone is concealed, its presence usually is indicated by fragments or well-rounded lumps of very white limestone float.

The writer measured the following section at an old quarry.

Section of Upper Washington limestone near Swarts.

	Ft.	in.
Shale and limy shale	10	
Limestone		10
Shaly limestone		5
Limestone	2	4
Shaly limestone		6
Limestone	1	
Shaly limestone		5
Limestone		9
Limestone	1	2
Shaly		2
Limestone	1	5

This quarry half a mile north of Swarts is close to the Waynesburg and Washington Railroad and is very noticeable from the highway on Bates Fork for it has a face more than 300 feet long of distinctly light color. It is on the Phillips farm, formerly owned by Ben Moore. A company of local farmers opened and operated this quarry to supply the railroad with ballast. Quarry cars were moved over a track of wooden rails to a trestle where they were dumped directly into railroad cars on a spur track, or to a jaw crusher.

The quarry was last operated by the State Highway Department about 1922, but 10 cars of screenings were shipped from it in 1924.

Probably the different layers of limestone shown in the section above differ in chemical composition as they do in physical character. The analysis in the subjoined table represents all of the beds combined, but omitting the shaly partings. It agrees very closely with the analysis of Upper Washington limestone at Holbrook on McCourtney Run. In neither place is the limestone of high quality.

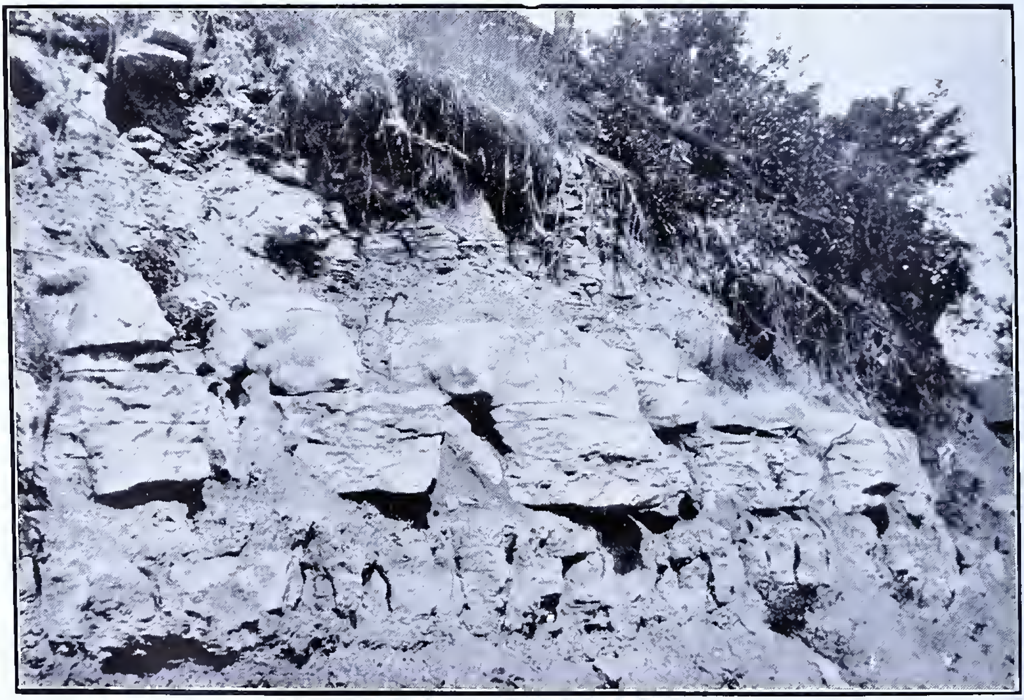

Fig. 41. Upper Washington limestone near Holbrook.

The other sample of Upper Washington limestone, No. 8 in the table below, was taken at the fork of the road at the mouth of Hoge

Run one-quarter mile below Holbrook. Here in the road bank and in the stream on the W. G. Hoge farm the limestone is well exposed.

Section of Upper Washington limestone at Holbrook.

	Ft.	in.
Shaly limestone and limy shale	8	
Limestone, massive, light color	2	8
Shale		6
Limestone, poor, knotty		4
Limestone, solid		9
Shale, drab, calcareous	3	
Limestone, dull flesh color		8
Shale	------	

The analysis represents only the 32-inch massive bed at the top, which is said to be the only layer in this locality that yields good lime.

Between Holbrook and the mouth of Pursley Creek the Upper Washington limestone is abundantly exposed on both banks of Tenmile Creek. It is about 7 feet thick and in many places is close above the road.

On a spur on the north side of Ruff Creek and one-third mile west of Craynes Run the Upper Washington limestone has been quarried by township commissioners for road metal. Under 5 feet of sandy gray shale and 8 inches of black shale lies 10 inches of grayish limestone, 2 inches of limy shale full of fossil shells, and 30 inches of blue limestone weathering white. This quarry is about 125 feet above the creek.

The Upper Washington limestone in the quarry near Swarts contains abundant minute fossils, apparently a bivalve crustacean or ostracod. To the naked eye they are little more than black specks

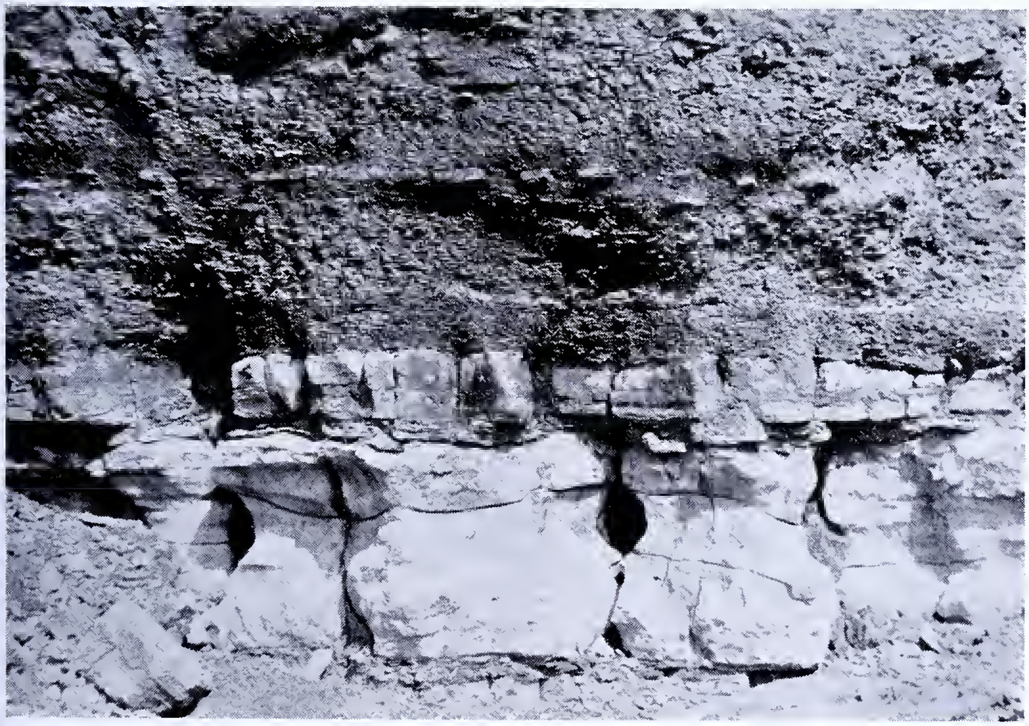

Fig. 42. Upper Washington limestone at Ruff Creek showing typical solution along joints.

but under a lens character becomes apparent. They are thought to be fresh-water animals. These fossils seem to be particularly abundant in the 10-inch and 28-inch beds near the top of the quarry face, but can be found by hundreds in the lower beds as well. Many of them are fragmentary.

A local limestone 2½ feet thick with 1 foot of very bituminous shale above it was burned by David Spragg on Roberts Run more than 50 years ago and the lime used in building his brick house. Bowlders of this limestone occur near Spraggs P. O.

Character. Although the limestones below the Pittsburgh coal, from the Ames to the Vanport, are definitely of marine origin, for they contain an abundance of fossils that certainly are the remains of animals that lived in salt water, the origin of the limestones above the Pittsburgh coal is uncertain. The Redstone is an impure limestone and the Fishpot resembles it where it is thin, but where thick it is likely to contain some layers of cement rock. The Benwood is very thick and some of its layers are highly magnesian. Other distinct beds, like the Uniontown, Waynesburg, and Upper Washington limestones are less or only slightly magnesian.

Their principal occurrence is between the Monongahela and Ohio rivers.

They can hardly be accounted for as accumulations of fresh-water marl, for the Benwood limestone 80 feet thick on the Monongahela may give place in a very short distance to a nearly equal thickness of shale and sandstone. Nor can it be assumed that they are calcareous muds for there seem to have been no limestone areas on any side from which such muds could be derived by solution or erosion. The highly magnesian beds may alternate with only slightly magnesian beds with seemingly almost continuous deposition and yet the former are difficult to regard as of fresh-water origin and their marine origin may be questioned because of an apparent almost total lack of marine fossils.

Analyses of limestones in Greene County.

[Pittsburgh Testing Laboratory, analyst]

	Benwood					Waynesburg		Upper Washington	
	1	2	3	4	5	6	7	8	9
Calcium carbonate	84.89	47.10	95.78	64.97	66.13	66.84	82.56	82.93	84.00
Magnesium carbonate	6.50	25.25	1.54	20.76	20.61	12.95	5.59	2.48	3.10
Silica	4.52	17.32	.96	8.96	7.20	11.40	5.92	8.32	7.28
Iron oxide	1.29	1.57	.43	1.43	1.00	1.72	1.57	1.14	1.29
Alumina	.91	5.73	.37	1.69	1.60	4.50	1.83	2.56	1.71
Titanium oxide	Tr.	.10	Tr.	Tr.	Tr.	.10	Tr.	.10	Tr.
Loss on ignition (other than CO_2)	.94	1.51	.61	.39	1.96	1.73	1.24	.94	.94
Alkalies and undetermined	.95	1.42	.31	1.80	1.50	.76	1.29	1.53	1.68

1. Benwood limestone, from bin of crusher operated by Commissioners of Morgan Township at Clarksville.

2. Benwood limestone. From face of quarry by railroad underpass on south side of ravine at Rices Landing. Represents 15 feet of bed apparently lower than No. 3.

3. Benwood limestone. Twenty-inch dark bed at bottom of Dr. Hoge quarry, Rices Landing.

4. Benwood limestone. Thirty-six inch bed just above No. 3.

5. Benwood limestone. Forty-inch bed just above No. 4.

6. Waynesburg limestone. Pulverized stone from crusher plant of Hart Bros., Carmichaels.

7. Waynesburg limestone. Outcrop at highway concrete bridge over railroad, 1¼ miles southwest of Jefferson.
8. Upper Washington limestone. Road exposure on W. G. Hoge farm, Holbrook
9. Upper Washington limestone. Quarry ½ mile north of Swarts.

SANDSTONE.

To one who has noted the number of old stone houses in country districts in the Cumberland-Lebanon-Lehigh Valley, their scarcity in Greene County is apparent. It cannot be for lack of suitable or durable stone for in every part of the county some one of the massive sandstones in the Coal Measures is available within a few miles. Evidence is not lacking as to the workability and durability of the local sandstones. It is not conspicuous but may be found at widely separated places.

At Carmichaels the abutments of the old covered bridge in town and ¾ mile below town are built of Waynesburg sandstone and have withstood the dampness and frost for several decades. The foundation of the First National Bank is of dressed Waynesburg sandstone from a quarry on Marshall Collins' land.

The power house of the Dilworth Coal Company at Rices Landing was built with the Pittsburgh sandstone taken from the shaft while sinking. Lock No. 6 at Rices Landing was built of Waynesburg sandstone, quarried nearby, as was also a stone house now about 150 years old.

An iron bridge over Tenmile Creek 1½ miles below Jefferson built in 1878 has sandstone piers and a farm house near it is also of local stone.

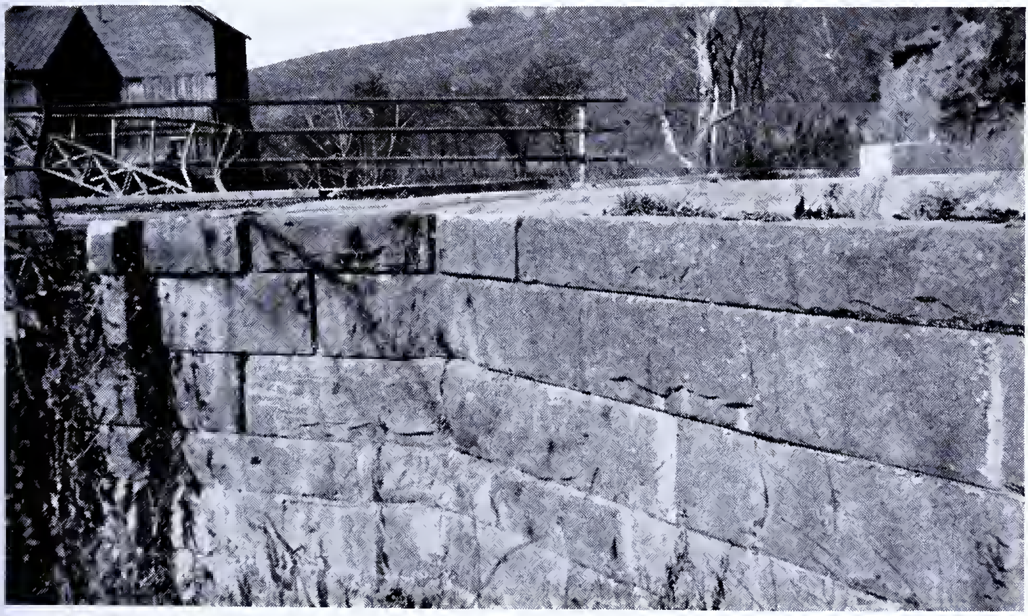

Fig. 43. Sandstone bridge abutment at Rogersville.

The Baptist church in Greensboro is built of sandstone quarried along the river above town and above the Pittsburgh coal.

At Rogersville the abutments of the bridge over Tenmile Creek are of stones 12 to 15 inches thick, 20 to 24 inches wide, and up to

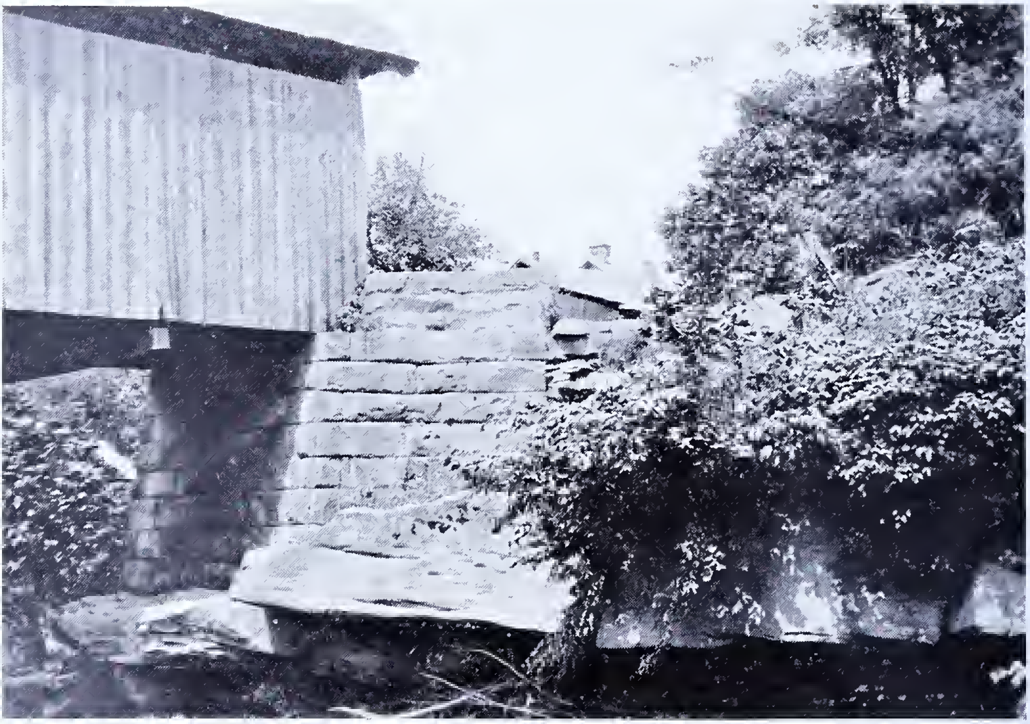

Fig. 44. Sandstone bridge abutment resting on sandstone ledge at Ryerson Station.

5 feet long. Old residents say they must have been quarried nearly a hundred years ago. These and some of the curb and flag stones in the village street are of local origin. The massive bridge stones are supposed to have come from a small quarry on the David Eaton (now Glen Morris), farm on Tenmile Creek 1 mile above McCourtney Run. Here the main quarry face about 30 feet long is on the hillside about 150 feet above the creek. It exposes a massive ledge 8 feet thick of soft, greenish, very arkosic sandstone. One shaped block remains in an adjacent small facing. This is about at the horizon of the Fish Creek sandstone.

On the Throckmorton farm near the forks of the creek ¾ mile west of Rogersville, the house has a dressed stone face and rough stone ends. It is a soft green sandstone quarried near by. Some of the corner stones up to 12 inches thick and 2 feet long still show chisel marks. The door steps are of slabs 8 inches thick, 14 to 24 inches wide, and about 46 inches long, all in good condition, in spite of the comparative softness of the stone. A tablet set in the gable is inscribed "This house was built for Ezra and Mary Sellers in the year A. D. 1823 by William Blair, ..." affirms the durability of the stone in house walls.

Likewise on the Frank Breese farm on Rush Run about ¾ mile above the mouth stands a stone house built probably as early as 1850. The stone used in this house, however, is mostly thin and slabby except the corners which are made of blocks 2½ to 3 feet long, 12 to 14 inches wide, and 4 to 5 inches thick, set on edge. The color is an unattractive greenish tan. Probably the stone came from a small

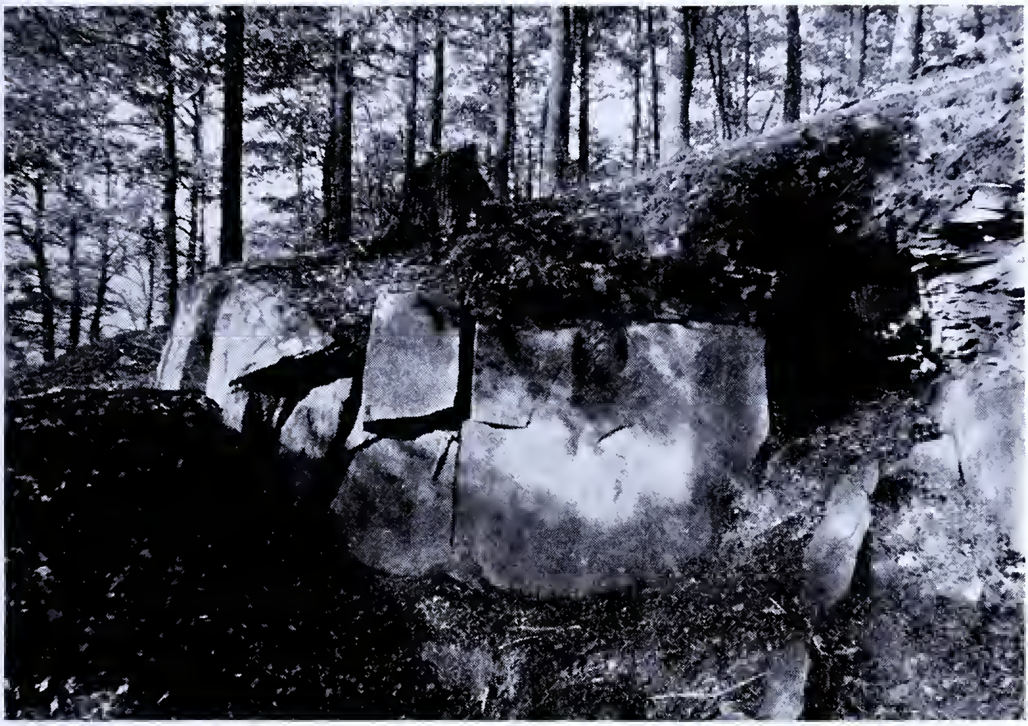

Fig. 45. Sandstone quarry on Glen Morris farm 2 miles west of Rogersville.

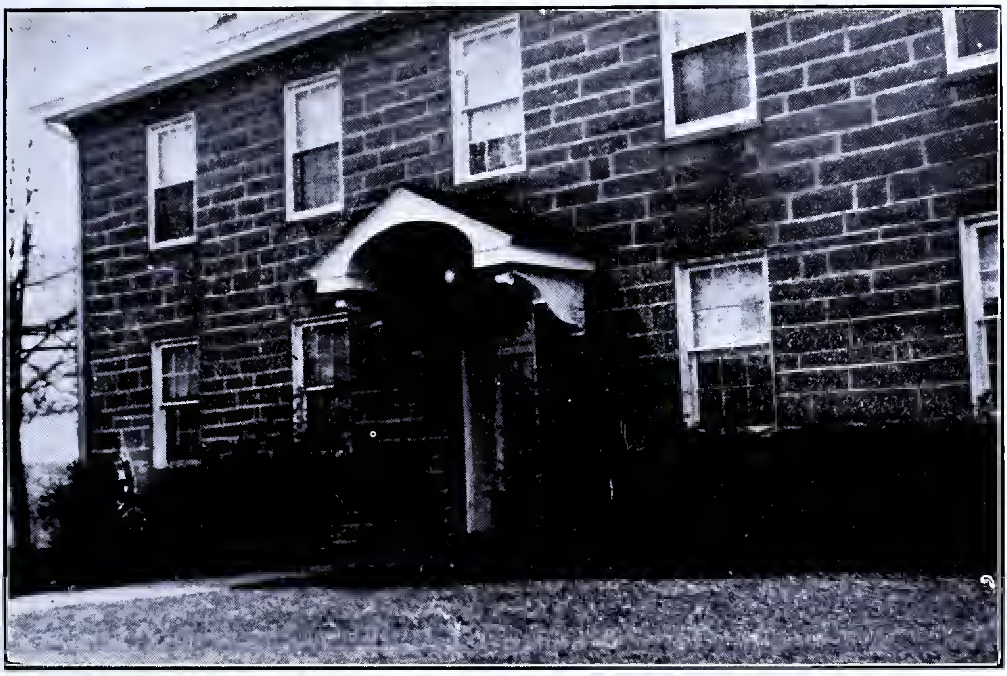

Fig. 46. Farm house on Smith Creek 1 mile south of Waynesburg, built about 1835.

quarry just back of the house and 40 feet above it. Although not good dimension material, the stone has lasted about 80 years without deterioration.

The old Hook farm house on Smith Creek about 1½ mile from Waynesburg was built of sandstone quarried on the farm about 1835. Apparently the stone in this house is in perfect condition.

At Swarts, one should notice the door step of the S. C. M. E. church. This is a single stone measuring 6 feet by 3 feet 8 inches, by 7 inches. It and the stones in the foundation of the church and of the old house across the road, and the barn by the station indicate the size, character, and durability of the stone that can be quarried at Swarts.

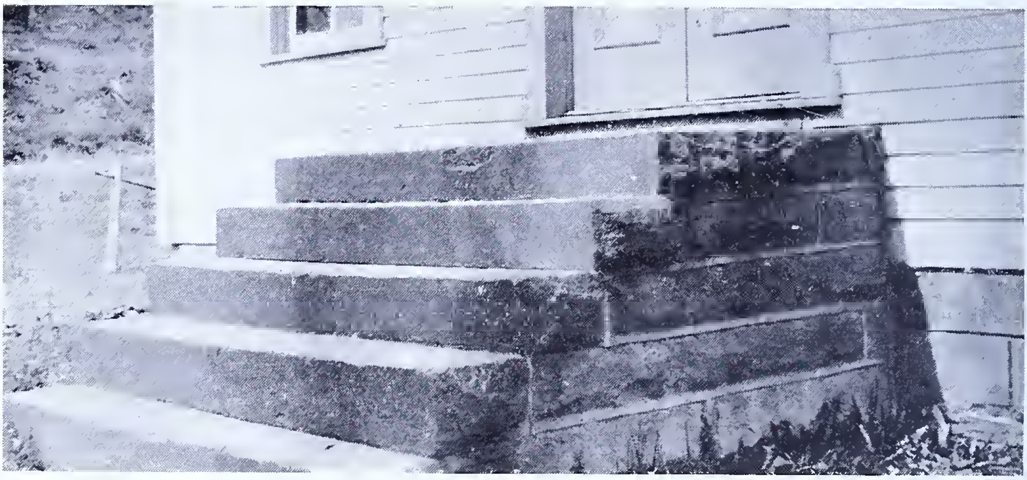

Fig. 47. Steps and foundation of church at Swarts, showing use of local sandstone.

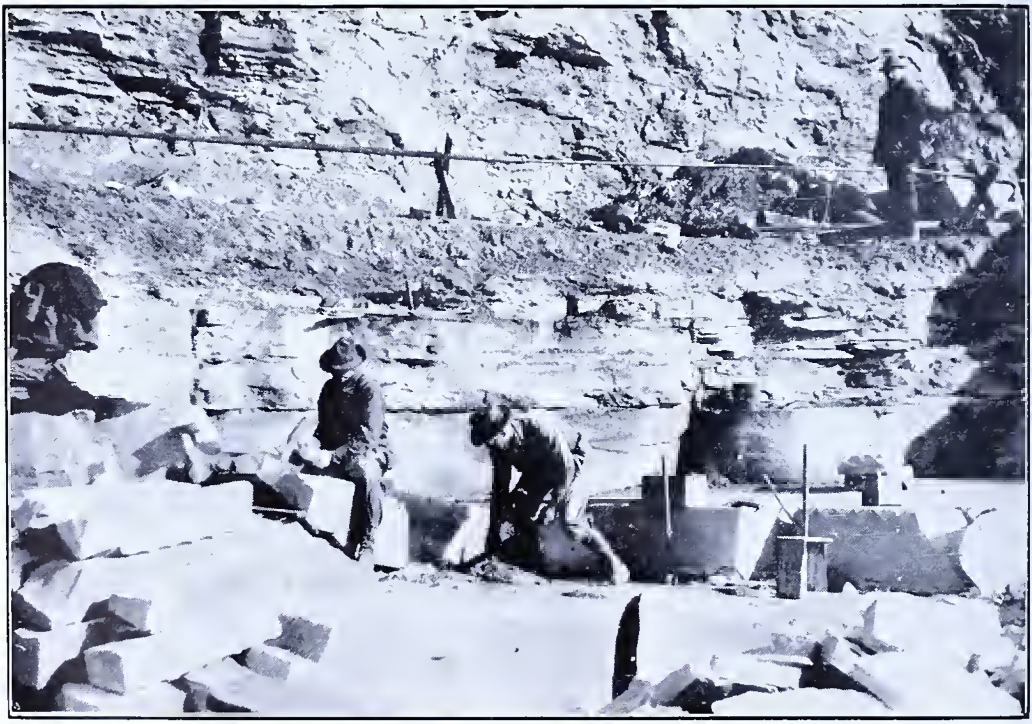

Fig. 48. Sandstone quarry at brick plant 1 mile south of Waynesburg. Shale in background is used for making brick.

Other stone houses occur throughout the county in the towns, and here and there on the main highways and in the back country. These few should suffice to carry the point that Greene County has sandstone that makes durable building stone. It must be admitted, however, that most of this stone weathers to a greenish tan or brown that would not generally be considered attractive.

A sandstone quarried near Waynesburg, however, has proved more desirable in this respect. It has been opened at several places but the only quarry now operating to produce dimension stone is that on the Hook farm 1½ mile south of Waynesburg. The Waynesburg Brick and Stone Company acquired the property from Rufus Ullum in 1906 and took out stone in the bottom of a small run about a quarter of a mile west of Smith Creek where there had formerly been a quarry. When the overburden became excessive, a brick plant was built to use the overlying shale. (See under Clay and Shale). Now there is a quarry face 500 feet long and 30 feet high in shale, and sandstone is quarried at its base or in the floor of the shale pit. The top 3 feet of the quarry is thin-bedded sandstone of no value for building. Below it are three layers each about 2 feet thick, then a 4-foot and a 6-foot layer, or 16 feet of good stone. Its color is uniformly light gray. All quarrying is by hand methods and admirable building stone is produced. Two men were engaged in its production in 1925.

The following description by G. H. Ashley was published in Bulletin No. 7 of the Pennsylvania Topographic and Geologic Survey, May 28, 1920.

"Recent studies by the State Geological Survey reveal the fact that hidden away in Greene County is what may prove to be one of the finest general building stones in the State.

"The stone in Greene County so closely resembles the Bedford limestone that the average person could not tell them apart. The Greene County product however is a sandstone and therefore has an advantage in that it is not affected in the same way as limestone. It is the same even light gray as the Bedford stone, and buildings in Waynesburg erected 15 or 20 years ago showing neither iron streaks or other stains indicate that in a rural district the color remains as clear as in the freshly quarried stone.

"The Greene County stone is massive bedded and remarkably even-grained both with and across the bedding. Blocks can be gotten out as large as can be handled. The stone is soft and easily worked when freshly quarried but the surface hardens with time. Tool marks on the stone in buildings 15 or 20 years old still show as sharp as when cut.

"Indeed, the Greene County stone seems to be ideal for office buildings, residences, and monuments. It has however at present, two handicaps. So far as yet traced, it lies in the hill in such a way as to require underground mining or very heavy stripping. In the second place, Waynesburg, near which the stone has been quarried, is connected with the outside world only by a narrow gauge railroad."

Representative buildings of this stone in Waynesburg are the J. T. Ullum, T. J. Huffman, C. H. Bowlby, and Joshua Wood residences, the South Side School, the First Christian Church, and Long store. The base and shaft of the Soldiers and Sailors monument in the village park are of this stone but the figures are carved in granite.

This particular ledge is said to have been opened on other farms on Smith Creek but is not worked. It should be found in the south

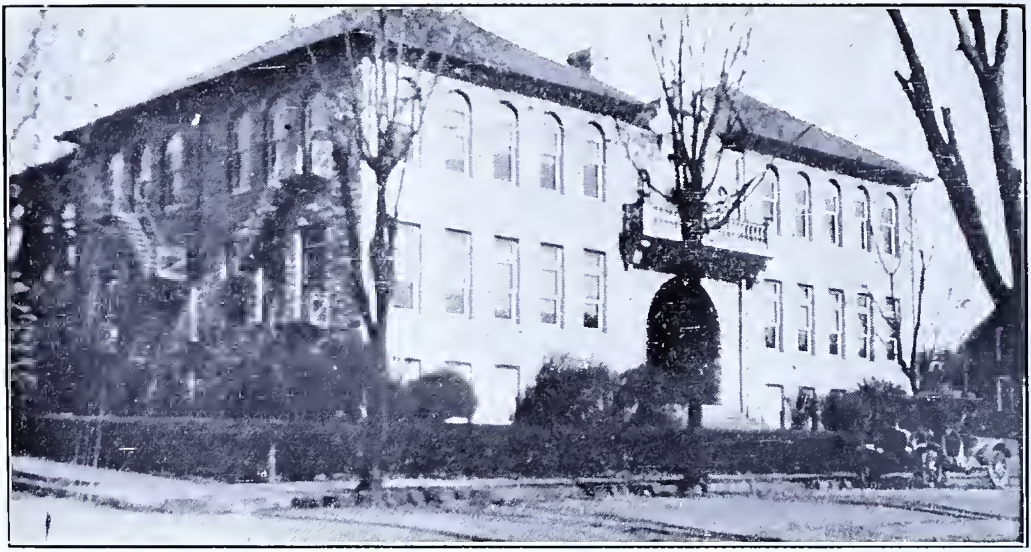

Fig. 49. South Side high school at Waynesburg built of sandstone from Hook farm on Smith Creek.

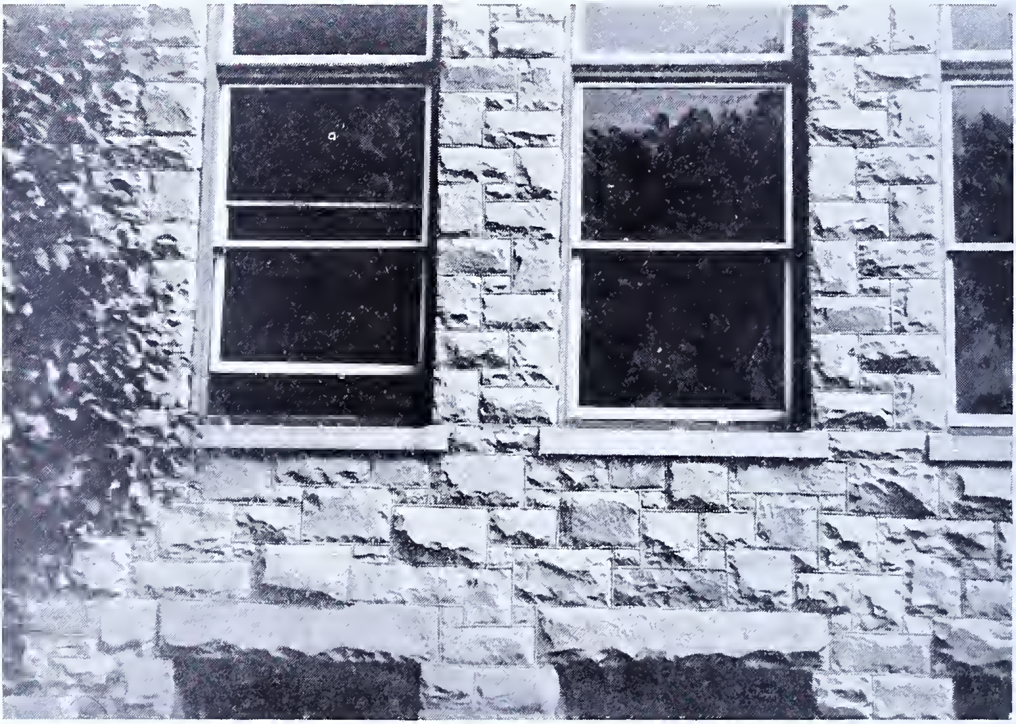

Fig. 50. Detail of sandstone in high school.

bank of Tenmile Creek opposite the railroad engine house at Waynesburg and about 50 feet above the water, but is concealed by talus and trees. The quarry high in the bank at this place, opened by L. W. Meek about 1900-1902 to furnish crushed stone for the village streets, is in much higher beds. This quarry has a face about 250 feet long on a 30-foot ledge. The upper part is irregular-bedded and slabby and the lower part massive. It looks as if good dimension stone might be obtained here, but it is said the stone does not split well. The overburden is 30 feet thick and would increase should the quarry face be advanced. This quarry has been idle for 20 years. When it was operated the stone was delivered by a bucket suspended on a cable slung across the creek.

The quarry just above water level on the south bank of Tenmile Creek opposite the tin mill seems to be at about the same distance below the Upper Washington limestone as the quarry now worked at the brick plant. It discloses 20 feet or more of massive and shaly sandstone. The massive stone seems slightly coarser grained and softer than that in the Hook quarry and is cut out at the east end of the quarry by a roll or abrupt change in the character and position of the bedding planes. This quarry on the Sayers farm has not been worked in many years.

From the slight evidence at present available it would seem that this very admirable building stone on the Hook farm near Waynesburg may be a very local condition, that elsewhere this particular stratigraphic horizon may be a slabby sandstone, or even be occupied by shale. The difficulty about greatly increased production of it near Waynesburg is the heavy cover encountered in advancing a quarry into the steep hillslopes. This is not insurmountable however for an astonishingly large quantity of stone can be taken from a comparatively small opening on a bed 16 feet thick.

Sandstone occurring about 50 feet below the Upper Washington limestone has been quarried for 200 feet along the highway at the cross roads one-third mile up Pursley Run on the L. H. Nichols farm. It is thin-bedded, cross-bedded, platy, micaceous, arkosic and wholly unsuited for building stone but has been used by the township commissioners for improving roads. At the road forks just below Oak Forest a sandstone in this same relation to the limestone crops out in the creek. It is rather massive and may have furnished the bridge abutments and house foundations in that hamlet.

At Rutan the creek bank has been riprapped and the road raised with rock from a road cut which exposes a ledge 4 to 5 feet thick of fairly soft, micaceous blue sandstone. This stone might dress to blocks 8 inches thick. Much of the riprap is 4 inches thick. It weathers to a greenish tinge. The position of this stone is above the Upper Washington limestone and may be near that of the Fish Creek sandstone.

On the head of Roberts Run 2 miles north of Spraggs is the Calvert quarry. It is on the east side of a hard road and about 50 feet above it. The face close to 200 feet long shows a rather massive sandstone 10 feet thick, overlain by brown shale. It is mostly a brownish-green sandstone but has some harder blue layers, and some micaceous layers that break in ½-inch plates. This quarry was opened for road material and operation discontinued when the highway was completed.

On Laurel Run 1½ miles above its mouth two quarries have been opened opposite each other and just above the road, on the Inghram and Wood farms. The ledge is about 15 feet thick, but the rather soft, arkosic, micaceous sandstone is rendered unfit for dimension stone by the irregularity of the bedding and joint planes. It was used for rough base of the concrete road.

At Carmichaels the Waynesburg sandstone is quarried by Hart

Brothers in the bank of Muddy Run at the north end of the main street. The upper 15 feet is soft but a cross-bedded ledge in layers 4 to 8 inches thick is hard and is quarried and crushed for coarse aggregate in concrete. A kerosene tractor and portable Champion jaw crusher were in use in 1925.

The Cumberland Township commissioners operate three quarries in the Waynesburg sandstone near Carmichaels for road material. One of these quarries is on the Marshall Collins place on Glade Run one mile southeast of town. The quarry face is about 50 feet high and 450 feet long. The upper 10 feet is soft and shaly, but 30 feet of the ledge is hard sandstone. It is mostly thin bedded and irregular, with some cross bedding, and breaks in lumps less than one foot thick. The bulk of the stone produced here goes in its rough broken form for improving country byroads, but some is crushed for concrete and for top dressing. A steam tractor runs one tripod drill and a small jaw crusher. The Waynesburg coal exposed in the corners of this quarry is mined for use in the steam tractor.

About 1½ mile farther down Glade Run just under the road on the east side of the valley a smaller quarry was used for a time to supply material for eliminating mudholes on this road.

The township was actively quarrying stone in 1925 in the bank of Muddy Run below the cemetery at Carmichaels. Here the Waynesburg sandstone is cleanly exposed 40 feet high and with little or no overburden. The rock is simply blasted down and hauled away without crushing for it breaks in pieces less than one foot in diameter. The sandstone is light gray, except where weathered brown, and soft; some is coarse grained, none massive. At this spot it is not suited for producing large building stone.

On the Caroline Gideon farm 1 mile north of Carmichaels, the Waynesburg sandstone is quarried for use on the county roads. The quarry face is about 25 feet high and the overburden is very light. The upper part of the ledge is thin bedded and of little use but the lower part is more massive and said to be good road stone.

Local sandstone was used many years ago for foundations of bridges at Ryerson Station, Durbin, New Freeport, and Deep Valley. The bridge at Durbin at the mouth of Crabapple Creek contains cut stone of various sizes, including 4 feet by 22 by 26 inches and 7 feet by 18 by 16 inches, laid without mortar, all in good condition after several decades.

In a similar manner other places where sandstones outcrop or have been quarried might be described, like that on the concrete highway just north of Mount Morris, or in the bank of Tenmile Creek between Waynesburg and Jefferson, but it would only go to show, as already has been indicated, that sandstone is abundant and widely distributed in the county, that good building stone can be had at some places and might be discovered at many others, and that the present market for sandstone is mostly as a foundation or filler on country roads and as coarse aggregate in concrete.

CLAY.

Both residual and alluvial clays occur in the county. The residual clays, derived from the decomposition of shales in place, are found on many hill slopes and crests. They are abundant but low grade. The alluvial clays or stream deposits occur on the flood plains and terraces of the larger streams. Terrace clays were formerly stripped at Waynesburg and made into red building brick. Good clay occurs at Jefferson but has not been exploited. A church was built in 1902 about a mile west of Khedive, from clay dug and made into brick on the spot. The Reppert house at Greensboro was built of brick made on the river bank in 1874, and the Ewing building of brick made from clay dug on the second bench about level with Sam Black's house.

Pottery was formerly made at Greensboro. The first plant was run by Hamilton & Jones, the second by Williams & Reppert. Both potteries were operating in the '80's and shipped their product by barge down river. Prior to the building of dam No. 7 in Monongahela River the clay for the potteries was hauled in wagons from a deposit two miles east of the river, fording at Greensboro. When the dam was completed in 1883, making navigable water at the old ford, ferry tolls on clay were avoided by opening a deposit of clay about 100 feet above the river back of Greensboro on an old river terrace. The product was blue stoneware in the form of jars, crocks, jugs, pitchers and novelties. They ranged in size up to 20 gallon jars, and all were turned by hand. Some of the smaller pieces were given a deep brown glaze. Mr. Reppert told the writer that he shipped 5 barge loads down river in one year, 30,000 gallons to each load. The pottery business at Greensboro was discontinued about 1896. Figure 51 shows a large and small crock and a pitcher made by Williams and Reppert.

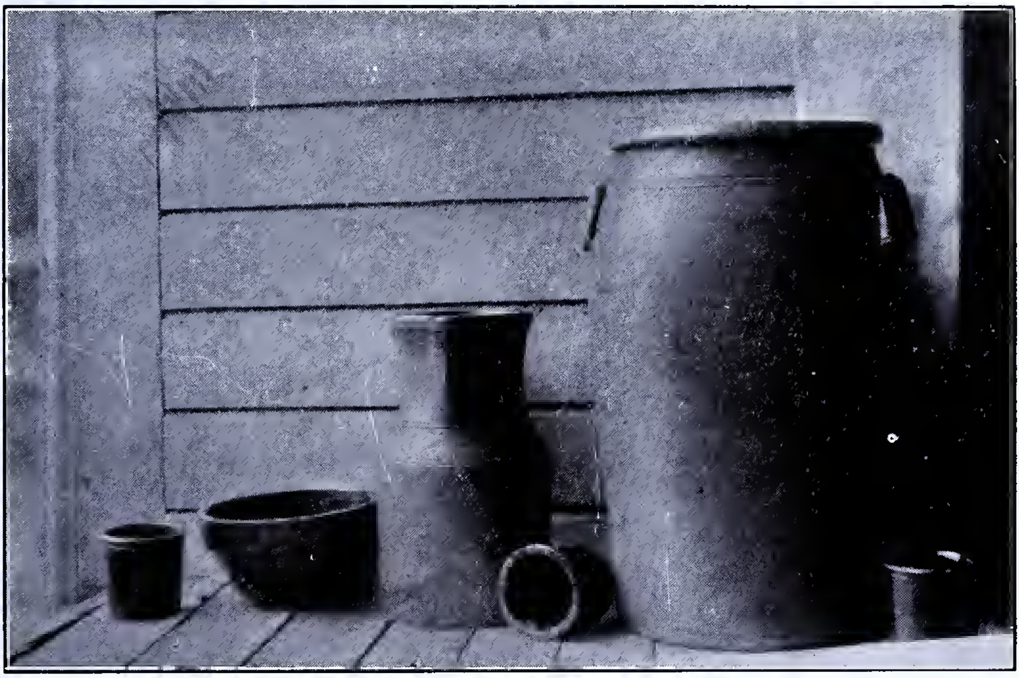

Fig. 51. Stoneware made at Greensboro from local clay.

Fire clay occurs beneath the coal beds but in many places is thin or so iron-stained as to be valueless. It is not utilized in the county.

According to Professor Henry Leighton,[1] in a letter to the writer:

"In mining the Pittsburgh coal bed in eastern Greene County a very persistent layer of fire clay is found separating the main coal from the roof coals. This layer is uniformly one foot thick. In Washington County at Courtney and Manown it has been used in making fire brick shapes and in the vicinity of California tests show it to be a fire clay fusing at 2800° to 2900°F. It seems probable that some of this could easily be recovered from the coal mines of the county and utilized for medium or low duty refractory products. Semi-fire clays include bluish gray crumbly clay layers with the appearance of fire clays but with much too low fusing points. A clay of this type is found just east of Rutan. It is about 4 feet thick and no doubt represents a type found in many localities. It is a clay of fair plasticity, high green strength and fusing at about 2381°F. Its burning qualities would indicate that it would make buff face brick or sewer pipe.

"A similar clay near Point Marion fused at 2462°F. and burned to a tan product suitable for drain tile or fire proofing."

SHALE.

Shales of fine texture are abundant and outcrop over wide areas in Greene County. As they are used elsewhere in southwestern Pennsylvania in the manufacture of brick, they would seem to offer the possibility here. Except along Monongahela River, however, railroad transportation is available in few places. Shale brick are made at only one place in the county in 1926, at that near Waynesburg.

Prof. Henry Leighton writes as follows:

"The shales of the county are abundant since about one-half of the 1800 feet of strata exposed in the hills and valleys of the county is shale. These shales after grinding generally become plastic and have the same uses as clay. With the exception of black shales which are not common in the county, and thin sandy blue shales such as seen up Smith Creek 3 miles south of Waynesburg, the shales of the county are suitable for brick manufacture most all can be used for common and face brick and some of better quality might be used for the manufacture of paving brick or sewer pipe. Red, blue and olive or tan are the prevailing colors with tan the most abundant. Good shales are found in the strata of the Conemaugh formation south from Grays Landing on the Monongahela River, in the Monongahela formation in eastern Greene County, in the Washington formation in Waynesburg and vicinity and in the Greene formation west of Waynesburg. The location of a favorable site for a plant depends largely on finding a shale which can be quarried without contamination with limestone layers or coal beds. In many cases such a shale bank may include red, blue and buff shales which are mixed to form the ware.

"Although good shales for red brick manufacture are found along Monongahela River probably the purest shales are those found in the central part of the county. These are especially accessible near Waynesburg. A shale 2 miles south of Cummins appears suitable for buff face brick or sewer pipe; another 3 miles north of Spraggs is adapted to the manufacture of red face brick, paving brick, or sewer pipe. The shale used by the Brick and Stone Company, Waynesburg, makes excellent face brick and might also be used for drain tile or floor tile. At New Freeport a red shale common in that region seems suitable for red face brick, drain tile or fire proofing.

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[1] Leighton, Prof. Henry, Department of Geology, University of Pittsburgh.

"The yellow surface clays are usually found on flat terrace plains 200 feet above Monongahela River and at less elevation above the main tributaries. This material is common in terraces west of Rices Landing and thence south through Paisley, at Jefferson, and elsewhere. It is a plastic yellow or white clay which burns to a buff color and seems adapted to the manufacture of face brick, sewer pipe or as was formerly done at Greensboro, the manufacture of crockery and roofing tile. Although a surface clay its fusion point is higher than the shales, averaging about 2552° F. Its use would probably be somewhat hampered by the difficulty of finding a large and sufficiently uniform bed of it for a large manufacturing plant. Its qualities, however, make it worthy of some study."

Six samples of shale and two of clay collected in Greene County have been tested in the Ceramics Laboratory at State College. The results of these tests, including specific gravity, linear and volume shrinkage, porosity, absorption fusion temperature, chemical composition, etc. can be seen in the office of the Geological Survey.

The Brick and Stone Company, formerly the Waynesburg Brick and Stone Co., was incorporated in 1914. F. R. Hill is president and A. L. Moredock secretary and treasurer. The former company bought land on Hook Run, 1½ miles south of Waynesburg, from Rufus Ullum in 1906 and opened a sandstone quarry about a quarter of a mile up the run from Smith Creek. In 1907 when the stone had been taken from the bottom of the run and overburden became heavy, a brick plant was built to use the shale overlying the sandstone. Development has advanced until in 1926 the face of the shale pit was 30 feet high and about 500 feet long. Resting on the quarry stone is 4 feet of blue clay. This is overlain by 20 feet of brown shale

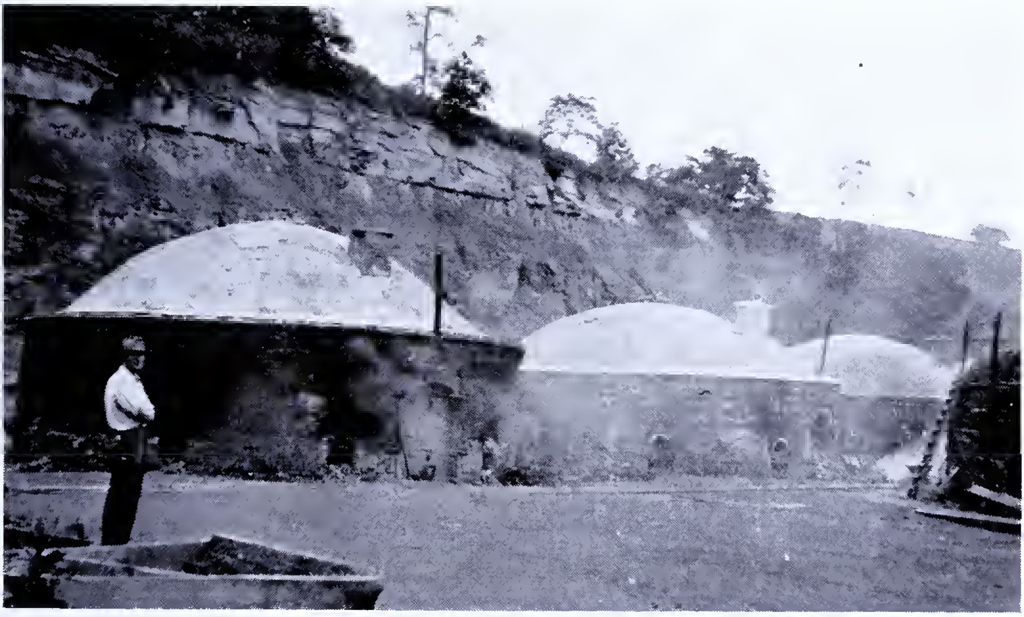

Fig. 52. Brick kilns 1 mile south of Waynesburg. Shale back of kilns is used, and underlying sandstone is quarried for building stone.

capped by 1½ feet of soft red shale. The top of the pit is in a thin bedded sandstone which is 14 feet thick at one end of the pit. The shale is dug with a 1⅛ yard steam shovel, loaded in quarry cars, and trammed by hand to the plant. All of the shale and clay between the two sandstones is used for making brick and tile.

The plant is equipped with a small jaw crusher, rotary screen, Freese brick machine, and 6 drying tunnels 100 feet long.

It is driven by steam power and the kilns are fired with soft coal.

The plant has five round, down draft, 30-foot kilns, each having a capacity of 70,000 brick or more. The product is tapestry and vertical scratch face brick, common red brick, and hollow building tile. The tile are made in two sizes, 5 by 8 by 12, and 4 by 5 by 12 inches. Tapestry brick are mingled shades of light and dark red to black.

Brick are hauled by automobile truck to Mather for rail shipment, and coal is carried from the Mack mine on the return trip.

This is the only brick plant in the county.

Samples of shale were collected by Prof. Henry Leighton, Department of Geology, University of Pittsburgh, in 1928 at the following places.

1. Bin of The Brick and Stone Company, 1 mile south of Waynesburg. A mixture of 3 feet of red, 10 feet of brown, and 4 feet of blue shale, from adjoining quarry.
2. Roadside exposure of 10 feet of red, buff, and blue shale at north base of high hill 3 miles north of Spraggs.
3. Thin splitting bluish sandy shale common on road 3 miles south of Waynesburg.
4. Outcrop just east of Rutan showing red shale underlain by 1½ feet of black shale and 4 feet of pseudo fire clay. This sample is of the fire clay only.
5. Buff shale at foot of big curving hill 2 miles south of Cummins.
6. East end of New Freeport, 8 feet mottled red shale under sandstone.

Clay samples were collected by Prof. Leighton from unconsolidated deposits of Carmichaels age at:

7. Top of hill leading west from Rices Landing.
8. Cellar excavation at Dry Tavern road forks 1 mile west of Rices Landing.

The eight samples were sent to Prof. J. B. Shaw, Department of Ceramics, State College who made tests in the fall of 1928 for the Pennsylvania Geological Survey and reports as follows:

Properties of shale and clay in green state.

No.	Water of plasticity Percent of dry weight	Shrinkage water Percent of dry weight	Pore water Percent of dry weight	Time of slacking, minutes	Drying shrinkage	
					Percent of dry volume	Percent of dry length
1	23.2	7.8	15.4	6	14.5	5.1
2	25.0	10.4	14.6	5	20.6	7.4
3	21.9	----	----	3	----	3.3
4	25.8	12.6	13.2	5	24.8	9.0
5	27.6	9.8	17.8	5	17.3	6.1
6	25.2	12.4	12.8	7	23.2	8.4
7	28.0	10.6	17.4	8	18.2	6.4
8	24.0	9.2	14.8	------	17.1	6.6

Fusion temperature of shale and clay.

No.	Cone	Degrees F.	Degrees C.
1	11	2,417	1,325
2	13	2,462	1,350
3	9	2,345	1,285
4	10	2,381	1,305
5	12	2,435	1,335
6	13	2,462	1,350
7	14	2,552	1,400
8	14	2,552	1,400

Properties of shale and clay in burned state at different degrees Centigrade.

	No.	1000	1050	1100	1150	1200	1250	1300	1350
Linear shrinkage	1	2.3	7.3	2.6	5.4	1.5	------	------	------
	2	2.9	7.6	7.7	5.8	1.2	------	------	------
	3	------	3.0	3.5	7.4	8.3	------	------	------
	4	5.0	5.6	7.1	7.0	1.5	------	------	------
	5	3.9	7.0	6.5	10.5	9.5	5.0	------	------
	6	5.4	8.2	8.5	5.8	6.5	7.6	2.0	4.6
	7	------	1.0	1.0	3.8	7.0	10.8	6.5	------
	8	1.0	1.5	5.8	4.0	5.5	7.0	6.1	------
Volume shrinkage in per cent of dry volume	1	6.2	20.3	8.0	15.3	4.8	------	------	------
	2	8.2	21.3	21.6	16.8	3.5	------	------	------
	3	—1.6	7.5	10.0	20.7	23.4	------	------	------
	4	14.5	16.0	20.1	19.8	—4.3	------	------	------
	5	11.2	19.8	17.9	28.5	26.5	14.4	------	------
	6	16.1	23.0	23.6	16.5	18.6	21.4	6.0	13.8
	7	0.0	2.7	2.7	11.0	19.3	29.4	—18.4	------
	8	—0.9	4.9	13.2	11.6	15.6	19.5	—16.5	------
Porosity in per cent of burned volume	1	13.7	9.3	8.9	0.7	15.3	------	------	------
	2	22.9	6.1	0.3	3.3	11.2	------	------	------
	3	38.2	39.1	44.0	18.9	11.3	------	------	------
	4	21.0	8.8	4.9	0.9	17.5	------	------	------
	5	26.8	17.5	12.5	1.4	0.5	3.4	------	------
	6	21.5	16.2	13.5	9.8	9.7	7.6	16.9	5.9
	7	32.4	30.1	28.2	20.8	11.7	2.2	33.9	------
	8	30.0	28.8	29.9	24.6	16.0	4.8	34.8	------
Absorption	1	12.2	8.5	8.2	0.6	13.3	------	------	------
	2	11.8	2.7	0.1	1.5	6.1	------	------	------
	3	24.4	22.6	22.2	9.5	5.5	------	------	------
	4	9.9	4.0	2.2	0.5	10.2	------	------	------
	5	14.2	8.3	6.1	0.6	0.3	1.8	------	------
	6	10.3	7.1	5.9	4.7	4.5	3.4	8.9	2.9
	7	19.0	17.1	16.0	10.7	5.7	1.0	23.2	------
	8	16.8	15.3	14.4	12.1	7.5	2.1	22.6	------

Specific gravity of shale and clay burned at different degrees Centigrade.

	No.	1000	1050	1100	1150	1200	1250	1300	1350
Apparent specific gravity	1	2.50	2.51	2.26	2.08	2.23	------	------	------
	2	2.46	2.45	2.35	2.22	2.08	------	------	------
	3	2.91	2.83	2.73	2.45	2.33	------	------	------
	4	2.71	2.38	2.37	2.29	2.12	------	------	------
	5	2.49	2.51	2.33	2.38	2.33	2.02	------	------
	6	2.65	2.72	2.65	2.33	2.39	2.42	2.26	2.2
	7	2.52	2.52	2.46	2.45	2.31	2.27	2.22	------
	8	2.56	2.66	1.98	2.70	2.54	2.35	2.38	------
Bulk specific gravity	1	1.86	2.02	1.87	2.05	1.66	------	------	------
	2	1.94	2.29	2.28	2.15	1.85	------	------	------
	3	2.13	1.74	1.72	1.99	2.07	------	------	------
	4	2.14	2.17	2.29	2.27	1.74	------	------	------
	5	1.89	2.08	2.04	2.34	2.28	1.95	------	------
	6	2.09	2.28	2.29	2.10	2.16	2.24	1.89	2.08
	7	1.72	1.77	1.76	1.94	2.05	2.22	1.46	------
	8	1.79	1.89	1.54	2.04	2.14	2.24	1.55	------
True specific gravity	1	------	2.66	------	2.32	------	------	------	------
	2	------	2.66	------	2.23	------	------	------	------
	3	------	2.63	------	2.38	------	------	------	------
	4	------	2.70	------	2.32	------	------	------	------
	5	------	2.58	------	2.38	------	2.47	------	------
	6	------	2.63	------	2.50	------	2.27	------	------
	7	------	2.80	------	2.38	------	2.32	------	------
	8	------	2.63	------	2.28	------	2.56	------	------

Modulus of rupture of shale and clay.

No.	Neat	Sand-clay 50–50	Fired at 1150° C.
1	366	186	3,738
2	429	195	4,007
3	80	----	3,377
4	419	123	3,235
5	281	135	5,287
6	324	131	2,187
7	282	87	1,953
8	----	----	------

Chemical analyses of shale and clay.

(Made under direction of T. W. Mason)

No.	Ign. loss	SiO_2	Fe_2O_3	TiO_2	Al_2O_3	CaO	MgO	K_2O	Na_2O	MnO	P_2O_5	SO_3
1	7.03	55.49	9.07	.06	20.91	2.35	2.11	.86	2.42	.08	.02	.00
2	6.93	57.34	7.65	1.19	22.49	1.60	.34	.89	1.43	.07	.26	.76
3	7.09	55.50	7.81	1.13	21.74	3.63	1.02	.87	.43	.22	.08	.51
4	7.81	56.91	6.31	.73	21.30	4.39	.18	.86	.36	.14	.09	.76
5	5.35	56.67	7.69	1.20	24.27	.82	------	------	------	.09	------	------
6	7.10	48.21	10.46	1.55	23.40	3.34	2.61	1.32	.76	.09	.87	1.16
7	4.20	59.98	3.51	.28	23.38	.50	.88	1.11	.87	.07	.01	.08
8	3.47	74.00	7.22	.37	12.21	.33	1.22	------	------	.65	.53	.00

GLASS SAND.

Should economic conditions arise whereby glass-making would be profitable in Greene County, it is possible that local stone could provide the sand. Places might be found where the sandstone above the Pittsburgh and Waynesburg coals and under the Mapletown coal would yield a satisfactory sand if properly ground, washed, and screened. It would not be such high grade sand as is produced elsewhere in the State for glass sand, but it would make common green glass.

This is evidenced by the fact that a glass factory was built at Greensboro in 1806 and used local sand. According to the story, when Albert Gallatin, former Secretary of the U. S. Treasury and founder of the town of New Geneva, was on his way to Washington, D. C., on horseback about 1794, he met a party of eight German glass blowers traveling west. He invited them to stop at his place, and, finding sand there and limestone, they settled and for several years made glass, using wood for fuel. Later (1806) they fell out with Gallatin, crossed the river and built a small settlement and glass works about a mile below the present site of Greensboro. They are said to have used sand found on the hillside back of the plant, and coal for fuel. Presumably the product was window panes, flasks and bottles. The only piece seen by the writer that is reputed to have been made at the old glass works more than 100 years ago is a light olive green flask owned by B. F. Gabler who lives near the site of the old works. (See Fig. 53). This flask is about 8 inches high and 5 inches in diameter, with a 3-inch neck.

The original glass blowers came from Alsace-Lorraine and called themselves Germans. The Kramer, Gabler and other families now living near Greensboro are their descendants.

Greensboro early became a thriving settlement and had 10 stores in 1810.

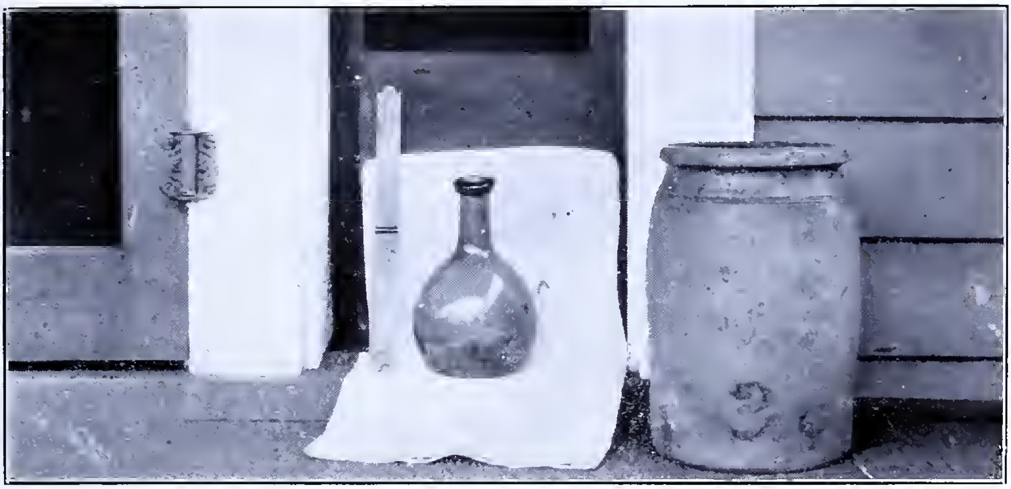

Fig. 53. Glass bottle made at glass works near Greensboro about 100 years ago from local sand. Crock also is a Greensboro product.

SAND AND GRAVEL.

The rocks of Greene County are very largely shale or soft shaly sandstone, and weather rather to soil than to sand and gravel. Deposits of these materials suitable for building purposes are generally small. The only commercial production of sand and gravel within the county that I observed is that of the McClain Sand Company at Point Marion, Fayette County.

This company digs its material from Monongahela River with a dipper dredge. (See Fig. 54). The dredge has washing and screening equipment so that washed sand is delivered to a barge on one side and washed gravel on the opposite side. When the stock of gravel at the plant is large, the gravel produced by the dredge may be piled in the river.

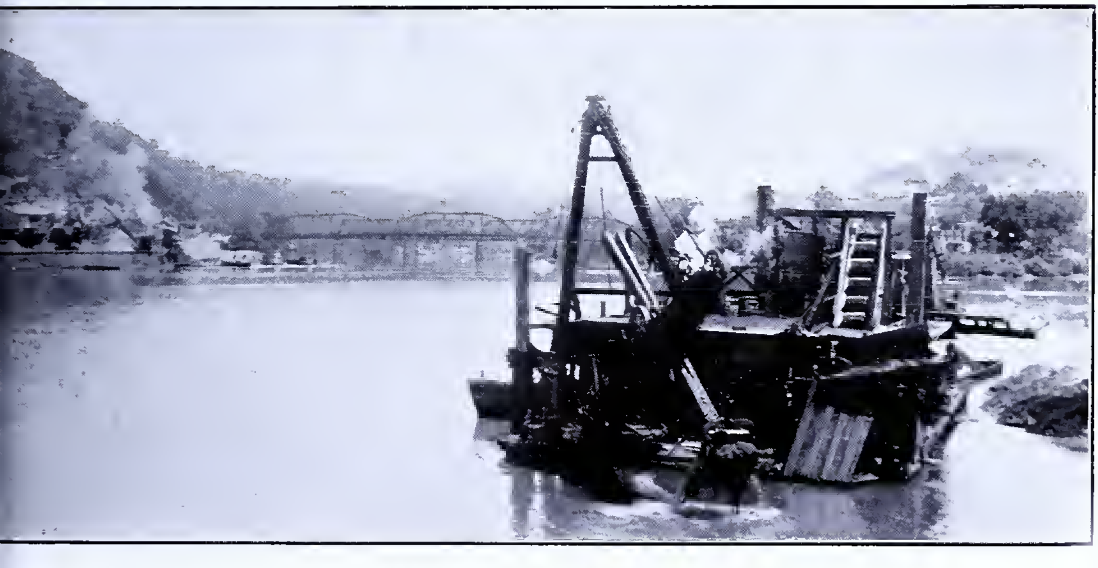

Fig. 54. Dredging sand and gravel along Greene County bank of Monongahela River. Point Marion and Cheat River bridge in background.

The plant is on the east bank of the river just below the bridge at the mouth of Cheat River. Barges brought to the plant by stern wheel steamer are unloaded by a steam crane mounted on a railroad flat car and by a stationary crane, both with clam-shell dredges. They deliver to stock piles or to railroad cars. The plant includes rescreening equipment. It is credited in the Industrial Directory as a Fayette County operation, but as shown by Fig. 55 some of the sand and gravel is derived from the Greene County side of the channel. The product is used for general building purposes.

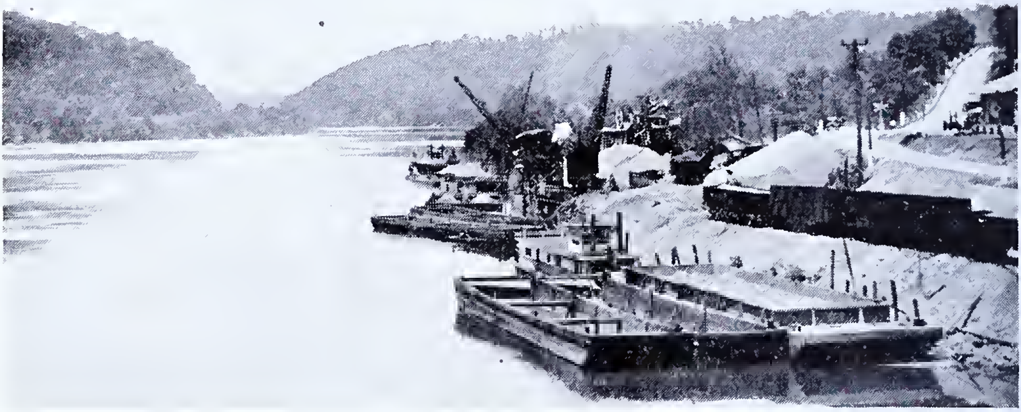

Fig. 55. McClain Sand Co. plant at Point Marion. Shows steep bluffs along Monongahela River, and piles of gravel along Fayette County bank.

IRON CARBONATE.

This discussion is not headed Iron Ore because that would imply deposits of such quality and quantity that the mineral can be mined commercially at a profit. However, the mention of iron cannot well be omitted, for it is accumulated in distinct, though at present economically uninteresting deposits. In all cases these are nodules of iron carbonate, occurring mostly in shale. They range in size from small nuts or a fraction of a pound up to a half bushel or 75 pounds. These lumps may be closely packed together in a nearly continuous layer several inches thick, or they may be distributed through several feet of shale, each lump of carbonate wholly isolated.

In Greene County these iron carbonate nodules occur more commonly within 10 feet below the Waynesburg coal and within 20 feet above the Upper Washington limestone. They are by no means everywhere present at these horizons and they do occur at other horizons, but at no place are they sufficiently abundant to be classed as an ore deposit. It is not unimaginable, however, that industry may some day demand or research find a use for iron carbonate nodules, and then their presence here will be of more interest than it is now.

Nodules scattered through shale below the Waynesburg coal on Hews Run, Morgan Township, were mined 75 to 100 years ago for reduction in an iron furnace at Clarksville, but the quantity was inadequate for profit.

Prospecting might disclose these nodules within a few feet below the Pittsburgh coal along Monongahela River for they occur below that coal in southern Fayette County.

On Browns Run in the southeast corner of Morris Township iron carbonate nodules are common from 10 to 20 feet above the Upper Washington limestone and also on Pursley Run about 2 miles above Oak Forest. At this latter place several acres of iron-bearing shale might be uncovered by thin stripping in the bottom-land at the junction of two small runs. The nodules are in five beds from 2 to 12 inches thick within 18 feet above the Upper Washington limestone.

Analysis of iron carbonate in Greene County.

[D. McCreath, analyst]

	1	2	3
Metallic iron	37.400	30.400	36.000
Sulphur	.278	.281	.047
Phosphorus	.285	1.405	.605
Insoluble residue	9.950	12.111	5.520

1. Above Washington coal, on Smith Creek, near Waynesburg.
2. Below Middle Washington limestone near Rogersville.
3. Above Upper Washington limestone near head of Pursley Creek.

These analyses by the chemist of the Pennsylvania Second Geological Survey are recorded as made from specimens. There is no suggestion that they were average samples and so may not be wholly representative of what could be obtained from the beds represented. The first is a very fair ore, the second is high in phosphorus, and the third is better than the second.

WATER.

Greene County is well supplied with water. Creeks and runs are numerous and make flowing water readily available. None of them carry sufficient water in summer time, however, to furnish water power. The streams are subject to unregulated flood, and to seasons of slight flow. Even the larger creeks, Tenmile and Wheeling, are likely to diminish in summer to such an extent that the water stands along their courses in pools. Because of this condition there are no dams in the county, except those at the locks in Monongahela River, and intake dams for water supply at Waynesburg and Mather. Owing to slack-water conditions, this river is navigable throughout the greater part of the year and affords an outlet for the products of the country about its headwaters at all times, except when it is choked with ice. Without its dams and locks, the Monongahela would be little better than a broad creek.

Springs and shallow wells are the source of water for domestic use. The springs, which are comparatively abundant in this region, come from various formations. The Upper Washington limestone is a frequent water producer, and springs from it are numerous. It is believed that the Waynesburg sandstone, which overlies the Waynesburg coal and often has a thickness of 40 feet, is usually a water-bearing rock. The wells sunk into it produce water of excellent quality, but care has to be taken not to penetrate the coal. The Fish Creek and other sandstones in the Dunkard series often furnish water.

Many farm houses are built close to a spring but most of them perhaps derive their water supply from shallow wells, that is, wells less than 50 feet deep. On all too many farms and at village homes due regard has not been given to location of the well with relation to possible sources of pollution and to protection against contamination. Many well mouths are not coped or sealed and there is nothing to prevent wash water thrown off the back porch from getting into the well. Many wells are within a few yards of a privy and contaminated by that proximity. Some people think that because a privy is down hill from a well, the well is safe from pollution from that source. The following diagram shows the possibility of a down hill location for a privy being a very dangerous one where the rock strata dip toward the well.

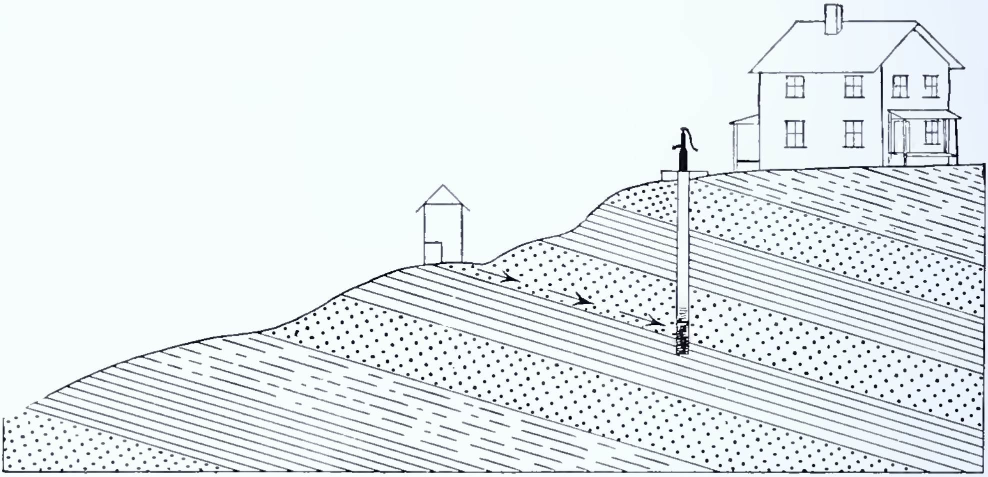

Fig. 56. Diagram showing well pollution.

A simple method of determining whether drainage from a privy reaches a well is to pour a gallon of kerosene into the privy. If there is underground connection with the well, the taste of kerosene will be recognized in the well water.

Waynesburg, which with East Waynesburg, has a population of 4,000 or more people, derives its water supply from Tenmile and Browns creeks, the pumping plant being at the junction of the two at the western end of the village. The Waynesburg Water Company, incorporated in 1886, built a low intake dam across Tenmile Creek. The water is coagulated, filtered, and chlorinated. The equipment for these processes and for storage is two 8-inch pipes to a mechanical filter plant having two 500,000 gallon units, and 75,000 gallon filtered water basin. The water is pumped through a 10-inch force main into a 1,000,000 gallon reservoir on a hill near the northwest corner of Waynesburg and 250 feet above the main street. The pumping equipment is a 2,000,000 gallon Worthington centrifugal pump, a 250,000 gallon Smith-Vaile pump used as auxiliary, and two 100 h. p. Gary water tube boilers. Distribution is by gravity through 11 miles of 4, 6, 8, and 10-inch mains with pressure from 90 to 165 pounds. In 1925 the company was serving about 1,350 consumers through meters. Only about 100 houses do not have this service.

The water is medium hard. It is analyzed weekly in the Morris Knowles laboratory, Pittsburgh.

An auxiliary supply may be secured in dry seasons from drilled wells, one at the pumping station, others at the brewery and cold storage plant.

Many people in Waynesburg use well water for drinking purposes, probably under a mistaken idea that it is purer or safer than that taken from the creek. In most places in Waynesburg a well sunk 17 to 30 feet will reach bed rock and furnish a sufficient quantity of hard water. The purity of water derived at shallow depth below the surface anywhere in the village is questioned.

The Waynesburg Coal Storage Company drilled an 8-inch well 134 feet deep at its plant in the village in March, 1901. This well struck water in the Waynesburg sandstone and yields a supply which has never been exhausted. Although the pump raises 75 barrels an hour, there is always about 90 feet of water in the hole. The water is soft and is used for the manufacture of ice.

Should Waynesburg desire to obtain an additional supply of water it is probable that wells drilled within the village on Purman Run would find it in the Waynesburg sandstone at less than 150 feet, or near the old tin mill west of the village at about 200 feet depth. Practically all of the wells drilled for gas near Waynesburg have yielded potable water at this horizon in what seemed to be inexhaustible quantities. This sandstone is approximately 35 feet thick, is overlain and underlain by relatively impervious shale, and forms a reservoir capable of holding a large amount of water. This bed receives water at its outcrop along Tenmile Creek and its tributaries east of the village, and dips west, so that there is promise of artesian water in this neighborhood.

Mather, a coal-mining town started in 1917 and having a population of about 2,000 in 1925, derives its water supply from Tenmile Creek. The water is coagulated, filtered, chlorinated, and pumped to a tank on a hill overlooking the village. Distribution is by gravity and all the houses in the village have water connections. Each house has a septic tank for sewage disposal.

Crucible, a town of about 2,500, built at the mine opened about 1912, pumps its water supply from the mine sump to a standpipe. The water is not piped to the miners houses but is taken from hydrants at the street curb. The water smells and tastes of hydrogen sulphide but is approved by the State Department of Health.

Nemacolin, a town of 3,000 people, has 475 houses with all modern improvements. The water supply is from seven drilled wells, and is pumped to a standpipe from which it is distributed by gravity.

The village of Jefferson is located on a terrace deposit of clays and gravels, and obtains its water supply from wells sunk from 20 to 60 feet through this material to bed rock. The supply is sufficient and but few of the wells have been known to go dry, except during a protracted drought. The water is hard. Some of the 400 inhabitants collect rain water from the roofs so as to have soft water for laundry purposes.

At Gabler's Riverside Creamery half a mile north of Greensboro, a drilled well 120 feet deep is pumped constantly for condenser water in the ice plant.

In all the other villages, which have populations ranging from 900 at Rices Landing down to 200 at New Freeport, and in the lesser settlements, the water supply is obtained from private wells which are from 15 to 50 feet deep.

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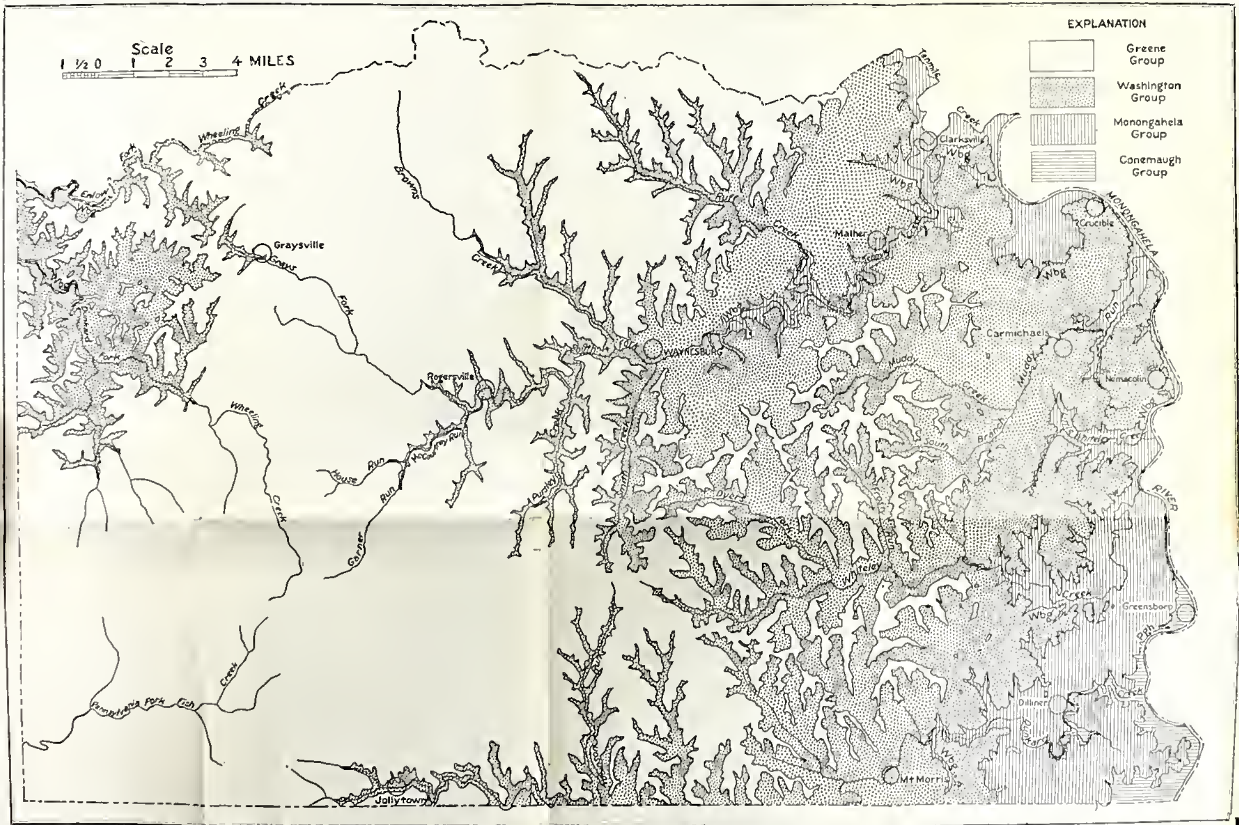
PENNSYLVANIA TOPOGRAPHIC AND GEOLOGIC SURVEY PLATE I



Pittsburgh coal outcrop is the line between Monongahela and Conemaugh groups marked Pgh; Waynesburg coal outcrop Wbg is the line between Washington and Monongahela groups. Errata: Location marked Dilliner should be Bobtown.

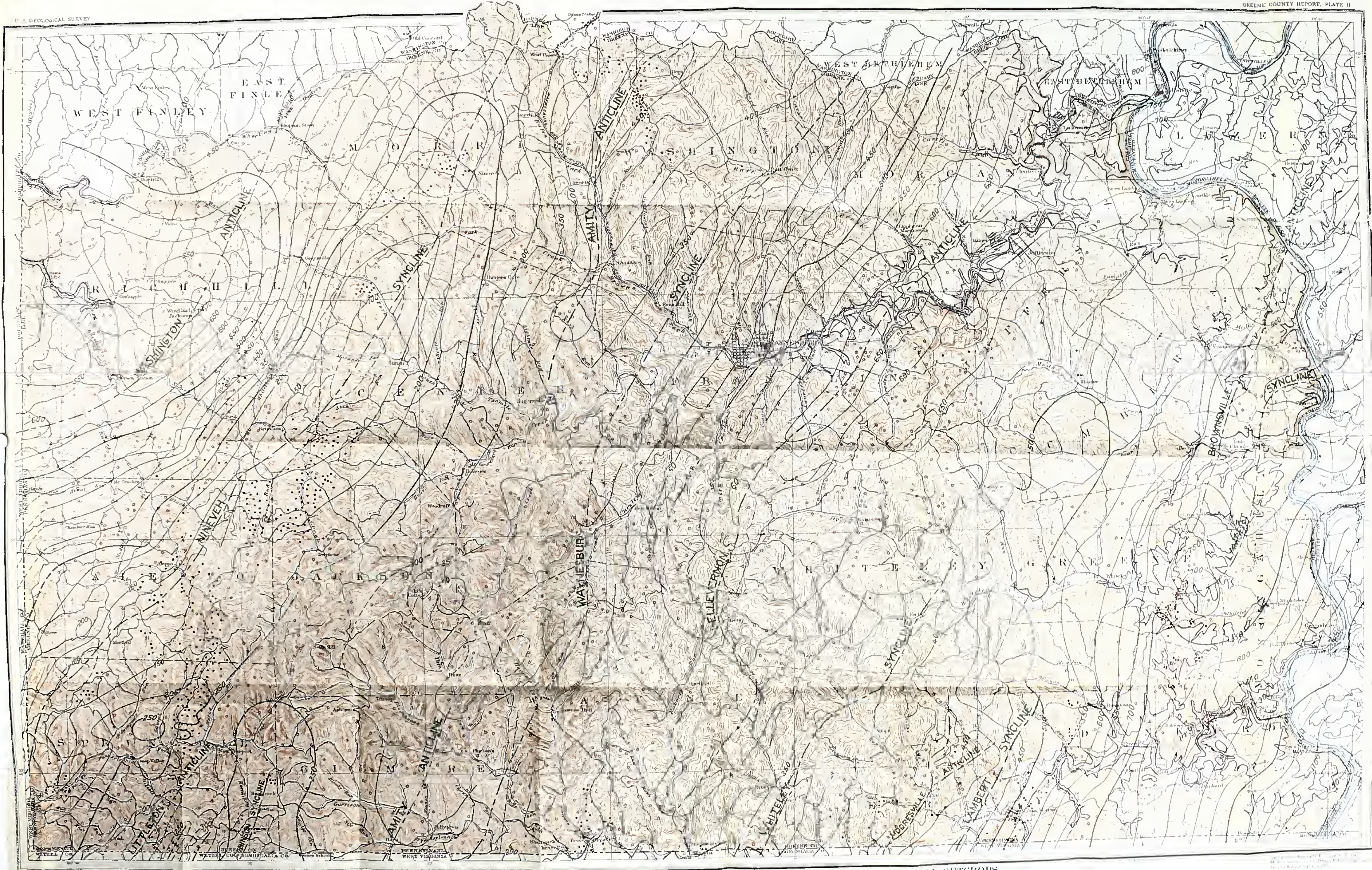
GEOLOGIC MAP OF GREENE COUNTY, PENNSYLVANIA

Geology by R. W. Stone, M. R. Campbell, and F. G. Clapp, after U. S. Geological Survey.

PENNSYLVANIA TOPOGRAPHIC AND GEOLOGIC SURVEY
GEORGE H. ASHLEY, STATE GEOLOGIST

U. S. GEOLOGICAL SURVEY

GREENE COUNTY REPORT, PLATE II



EXPLANATION

Structure contours on Pittsburgh coal
(Contour interval in feet, datum mean sea level)

- ● Oil well
- ○ Gas well
- Dry well
- • Show of oil
- ○ Show of gas
- ○ Gas well abandoned
- Well location
- × Coal mine, shipping
- • Coal mine, small

Coal outcrops
Pittsburgh, pb
Sewickley, sw
Waynesburg, wb

Topography surveyed in 1899–1903
by U. S. Geological Survey in cooperation
with the Commonwealth of Pennsylvania.
Towns and railroads built since 1918 added.

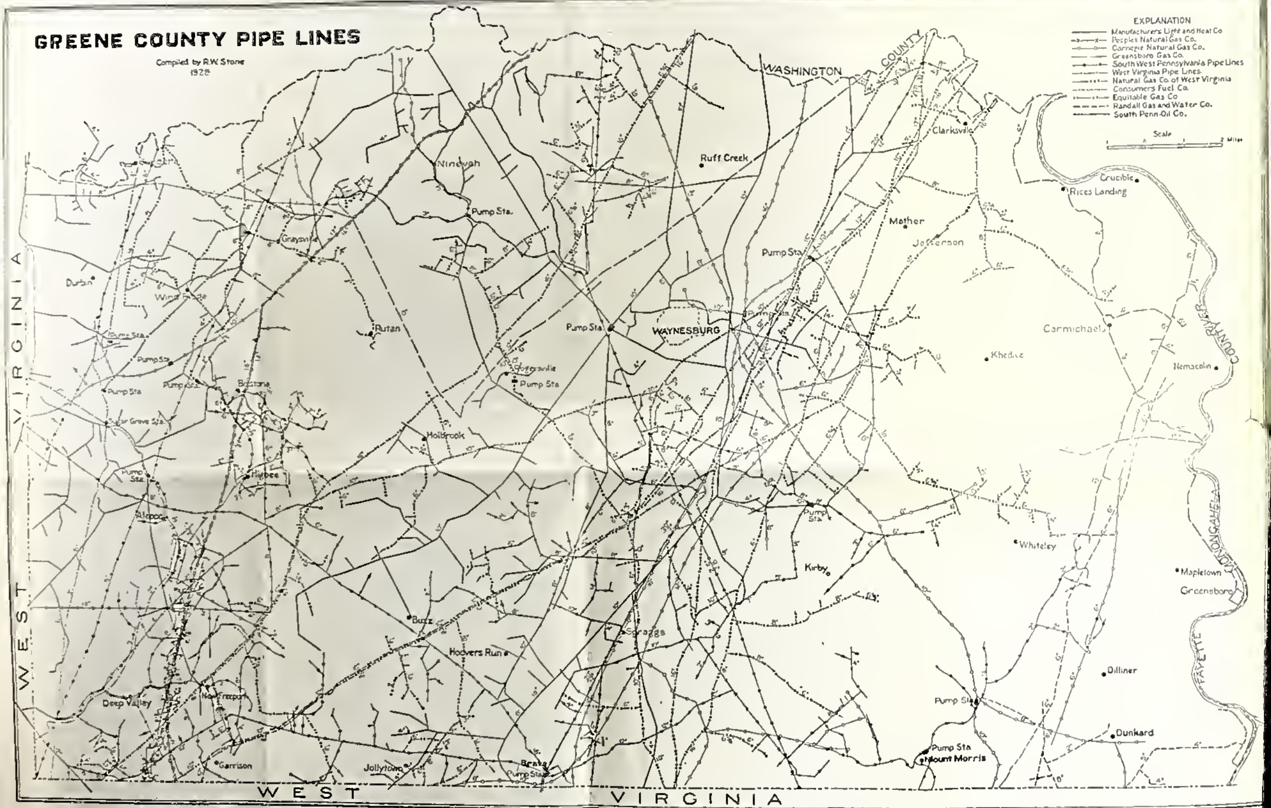
MAP OF GREENE COUNTY, PA., SHOWING OIL AND GAS WELLS, STRUCTURE CONTOURS, AND COAL OUTCROPS
BY
RALPH W. STONE AND FREDERICK G. CLAPP

Scale [illegible]

Miles

Kilometers

Contour interval 20 feet
Datum is mean sea level
1930



MAP OF PRINCIPAL OIL AND GAS PIPE LINES IN GREENE COUNTY, PENNSYLVANIA